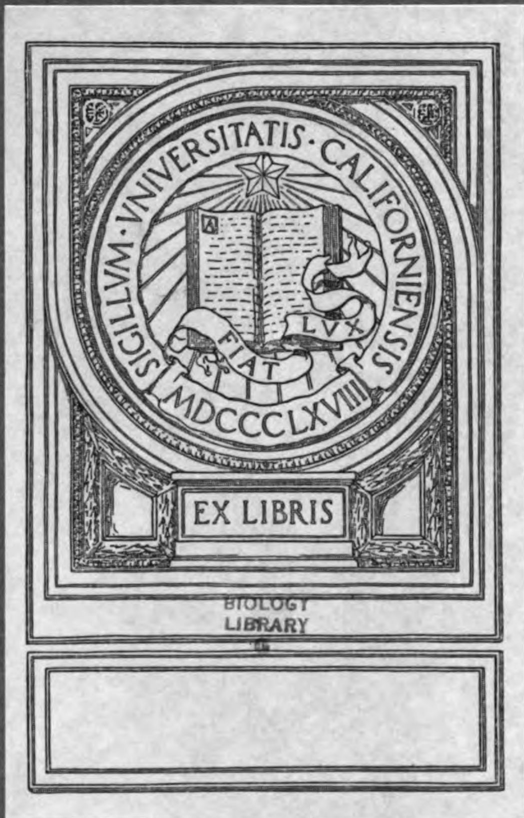
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Royal Army Medical Corps

EDITED BY

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VOL. LXI.

July—December, 1933.

JOHN BALE, SONS & DANIELSSON, LTD.
83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W. 1.

No. 1. July, 1933. Vol. LXI.

Journal OF THE Royal Army Medical Corps

ISSUED MONTHLY

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JOHN BALE, SONS & DANIELSSON, LTD.
83-91, GREAT TITCHFIELD STREET, LONDON, W.1

Price Two Shillings net

Vol. LXI | July, 1933. | No. 1

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Journal of the Royal Army Medical Corps.

Original Communications.

REPORT ON AN INVESTIGATION OF ENERGY EXPENDED ON THE EXERCISES OF THE PHYSICAL TRAINING TABLES FOR RECRUITS OF ALL ARMS.

By Major T. F. KENNEDY, O.B.E.,
Royal Army Medical Corps.

CONTENTS.

Introduction.

The object of this investigation is to give a scientific backing to tables that have been drawn up more or less empirically, and to ascertain whether the energy expenditure value of exercises, both individually and in groups, corresponds with that assessed by their relative position in the tables.

It is fully realized that the number of experiments carried out on each exercise is not sufficient to give a reliable average, but time was short and a repetition beyond what was effected, however desirable it might be, was found impossible.

Thus values which might suggest an alteration in the position of certain exercises in the tables should not be too freely accepted; they rather point to the need of their being particularly chosen for further research.

A study of the results discloses the fact that in many instances considerable variation in the cost of the same exercise occurs. This certainly is to be expected in a subject such as Physical Training, in which one of the main watchwords is "Self Effort," for self effort, even in the most enthusiastic of performers, must vary between wide margins dependent on the amount of mental and physical well-being existing at the moment.

A trained Staff Instructor was specially selected as the subject of the experiments in order that the exercises might be performed as they should be according to the Manual, and thus give a truer picture of the metabolism than that likely to be obtained from an untrained or partially-trained man. Moreover, as relative rather than absolute values were wanted there was no necessity to have more than one subject.

The plan of campaign followed was to carry out one investigation of each exercise in the eight tables and then repeat as much of it as time would permit.

Horse and ground work were omitted altogether because of the difficulty of collecting samples of expired air; and even had this been possible the effect of wearing the apparatus would have so interfered with the proper performance of the exercise that the results would have been very fallacious.

A preliminary series of single experiments was carried out on all the exercises in the first eight tables, but as time precluded every one of these exercises being repeated it was decided to concentrate on the first six tables only and make as complete an investigation of these as was possible in the time. A second examination was carried out on all exercises in Tables I to VI with the exception of the Agility group. A third examination was then conducted of those exercises where the expenditure in the first two investigations showed a variation of more than ten per cent. In a few instances, where the results seemed to vary unduly, a fourth examination was made. It is thus claimed that for the first six tables the mean figure arrived at is somewhere near the correct mean energy expenditure value of the various exercises and groups, but it should be understood that this investigation by no means pretends to be of the nature of an academic research. It expresses rather the energy expended in physical training as carried out under the ordinary conditions of a military gymnasium and it is hoped that for this reason it has a greater practical value.

It will be noted in many instances that the results obtained do not accord with the progression of the exercises. This does not necessarily mean

that progression is absent, for other factors may have a decided influence, e.g., localization of effort to a particular muscle group or the introduction of more complicated co-ordinated action, in which case the strain is nervous rather than muscular.

The interpretation of the results has been grouped in the following way:—

(A) Classification of exercises into homogeneous groups showing the gradation in energy expenditure as progression occurs.

(B) Classification of exercises into "sequence" groups according to the tables in which the progression of each group in the different tables can be observed.

Fig. 1.

(C) Tabulation of the exercises of Tables I to VI, in their group, by order of their energy expenditure values.

(D) Comparison of the first six tables showing the mean value of the exercises in each group, also the mean of the total exercises in each table.

(E) Comparison of all eight tables, including Jumping and Vaulting groups, but omitting Horse and Ground Work.

The results obtained are only an indication of the general metabolic change occurring at the time of the experiment and do not throw any light on the particular strain of any individual muscle group.

An analysis of the muscle groups involved in the exercise will help to decide the degree of strain present, for a metabolic rate which is low for some general effort of the body might be very high for some particular muscle group and indicate an excessive strain on it. Cathcart and

Fig. 2.

Benedict found that the maximum effort capable of being sustained by the larger muscle groups of the body working together was approximately 600 calories per square metre of body surface per hour. The experiment was performed with an ergometer by a trained cyclist doing 100 miles a day. Naturally, where the exercise singles out less powerful muscle groups the maximum effort capable of being sustained by them must reach a much lower figure than that quoted, and for the same reason therefore one should not expect to find progression between different homogeneous groups.

The suggestion of carrying out this investigation originated from Major D. T. Richardson, M.C., R.A.M.C., and the work has been executed throughout under his guidance. He has scrutinized the results obtained and approves of the general framing of the report. The general idea of the work was approved by Professor E. P. Cathcart, F.R.S., and sanction for obtaining the apparatus and for carrying out the experiments was very kindly afforded by the Director of Hygiene.

Fig. 3.

Apparatus.

The method employed in this investigation was the Douglas-Haldane, i.e., the expired air was collected in the Douglas bag and analysis was carried out by the portable Haldane apparatus. Details of the apparatus and the method are described by Professor E. P. Cathcart in his paper in the Journal of the Royal Army Medical Corps, November, 1918, entitled "Method of Estimating Energy Expenditure by Indirect Calorimetry (Douglas-Haldane method)." In certain cases it was found necessary to add an extension of corrugated rubber tubing between the mouthpiece and bag. The different methods of collecting the samples of expired air are illustrated in figs. 1 to 3.

The Haldane gas-analysis apparatus was received new from the makers with a certificate as to its accuracy. This was borne out by repeated analyses of air carried out at intervals during the investigation; consequently no correction of results was deemed necessary.

The gas meter used had also been recently overhauled and checked by the makers, so one can infer that it was correct in its readings.

All experiments were carried out at the Army School of Physical Training, Aldershot, between January and July, 1932.

The Subject of the Experiments.

It was considered that one subject was sufficient as the object of the investigation was to discover relative rather than absolute values of the exercises, and also, by limiting the tests to one subject, a great economy of time was effected: this was of vital importance as the investigation had to be completed within a definite period, owing to the imminence of the author's departure for service overseas.

For the subject a Staff Instructor of the Army Physical Training Staff was chosen as it was considered his training and knowledge of the work would ensure the exercises being properly performed, and less variations in self effort would be apparent. He was of well-built athletic frame, aged 27 years, height 165·5 centimetres, weight 68·2 kilogrammes, and a good boxer, being Welter-Weight Champion of the Army from 1926-1932. He was in excellent training during the course of these experiments as the championship boxing meeting took place about half way through the investigation. He led a healthy and very regular life, was a moderate smoker and to all intents and purposes a total abstainer.

A weekly record of his surface area was kept and, as can be seen from Table I, there was very slight variation in his general condition throughout.

Table I.—Surface Area of Subject.

Age	Height in centimetres	Naked weight in kilogrammes	Surface area in sq. metres	Date
27	165·5	68·2	1·77	8.2.32
,,	,,	68·2	1·77	18.2.32
,,	,,	68·0	1·77	22.2.32
,,	,,	67·6	1·76	29.2.32
,,	,,	67·1	1·75	7.3.32
,,	,,	66·5	1·74	15.3.32
,,	,,	66·6	1·74	21.3.32
,,	,,	66·6	1·74	29.3.32
,,	,,	66·75	1·74	4.4.32
,,	,,	66·75	1·74	18.4.32
,,	,,	67·8	1·75	25.4.32
,,	,,	67·5	1·75	3.5.32
,,	,,	66·5	1·74	11.5.32
,,	,,	66·4	1·74	18.5.32
,,	,,	67·6	1·76	23.5.32
,,	,,	67·3	1·75	1.6.32
,,	,,	67·6	1·76	7.6.32
,,	,,	68·2	1·77	13.6.32
,,	,,	68·0	1·77	20.6.32
,,	,,	67·75	1·76	27.6.32
,,	,,	67·4	1·75	4.7.32
,,	,,	67·1	1·75	11.7.32

He was of rather a temperamental disposition and this led to some variations in the degree of effort depending on the zest for working existing at the moment. It was very noticeable that at the beginning of the investigation, whilst the whole idea was still novel, he was far more spontaneous in the amount of "pep" he put into individual exercises than later on when the novelty had worn off and a certain amount of supervision became necessary to obtain proper performance.

Basal Metabolic Rate.

In order to check his basal metabolic rate throughout the course of the investigation a series of samples was taken at intervals, about 7 a.m. in bed, a few moments after he had awakened (see Table II). The mean value of these observations comes out at 41·15 calories per square metre of body surface per hour, a figure within reasonable distance of that laid down by American workers (39·7 calories) and also of that found by Richardson in his "Investigation of the Energy Expenditure of the British Soldier in India" namely 43·59 calories — the figure for Infantry after a night's rest, the sample being taken after awakening without waiting thirty minutes.

Table II.—Basals—After Night's Rest.

Experiment	Per min.		A.R.Q.	Per hour		Remarks
	Oxygen c.c.	Carbon dioxide c.c.		Cals.	Cals. per sq. metre	
1	0·251	0·185	0·78	71·28	40·26	
2	0·250	0·190	0·80	71·34	40·30	
3	0·337	0·237	0·78	95·52	52·98	Was considerably perturbed by the fact that the Staff Instructor taking the sample had disturbed his wireless set. This reading is omitted in calculating the mean
4	0·253	0·192	0·80	71·70	40·51	
5	0·280	0·211	0·84	80·64	45·56	
6	0·264	0·201	0·80	75·42	44·62	
7	0·265	0·220	0·84	76·98	44·23	
8	0·238	0·214	0·92	70·40	40·37	
9	0·270	0·219	0·85	77·88	44·76	
10	0·250	0·206	0·86	74·04	42·07	
11	0·240	0·183	0·80	68·16	40·55	
12	0·220	0·184	0·87	64·08	36·41	
13	0·230	0·183	0·84	65·70	38·88	
14	0·224	0·178	0·83	64·50	36·63	
Mean for all experiments	..		..	..	41·15	

It is thought that these figures can be taken as being reliable sleeping values as the usual routine, before these experiments, was a light meal at 8.30 p.m., consisting of eggs or chocolate with bread, butter and tea, and bed about 10.30 p.m. He slept very soundly and often had to be awakened for the samples to be taken.

METHOD OF CALCULATION.

In calculating the energy expenditure oxygen figures and the Zuntz values were employed. Full details of the method are given in Professor Cathcart's "Method of Estimating Energy Expenditure by Indirect Calorimetry (Douglas-Haldane method)."

ORDER OF CARRYING OUT TESTS.

(*a*) One examination of each exercise in Tables I to VIII (Horse and Ground Work omitted).

(*b*) A second examination of each exercise in Tables I to VI (Jumping and Vaulting, Horse and Ground Work omitted).

(*c*) A third examination where the results of the first and second differed by more than ten per cent in the number of calories expended per square metre of body surface per hour.

(*d*) A fourth examination where the results of the first three differed considerably.

The experiments were nearly all made in the morning about one hour after a breakfast which usually consisted of porridge, bacon and eggs, bread and butter, tea, etc.

RECORD AND INTERPRETATION OF RESULTS.

The interpretation of results must necessarily be a difficult matter in Physical Training exercises in which the energy expended is largely proportional to the amount of "self effort" exerted.

It was found that during the first fortnight or so of the investigation the CO_2 figures were high. This was probably caused by unnatural breathing due to the subject being unaccustomed to the apparatus.

Considerable variations in respiratory quotient were observed. These are discussed in detail in Appendix II.

A. CLASSIFICATION OF EXERCISES INTO HOMOGENEOUS GROUPS SHOWING THE GRADATION IN ENERGY EXPENDITURE AS PROGRESSION OCCURS.

In this classification the exercises have been grouped under the headings Marching and Running, Introductory, Heaving, Lateral, Balance, Abdominal, Dorsal and Final, as shown in the Physical Training Tables, and then an effort has been made to subdivide these large groups into smaller divisions where the exercises are more closely related to each other and where progression may be more suitably illustrated; these have been called homogeneous groups.

Plates are mentioned in a number of the exercises in order better to illustrate the correct method of performance. The table number of each exercise is given, also the cadence where such is considered relevant. In certain instances where the progression in energy expended does not tally with the progression in the tables, any factor which might have a bearing

on the interpretation, such as localization of effort to a particular muscle group, is discussed.

[*The Plate and Figure Nos. quoted in the various Exercise Tables refer to the illustrations in the "Manual of Physical Training,"* 1931.]

(I) *Marching and Running Exercises.*

This group includes, besides marching and running, all the exercises of the legs which are performed on the move and which are not included in other groups. The marching exercises are usually performed by a class in line, the object being to improve each man's stride. The correct step should be maintained, but men should be allowed to take their most easy and natural length of pace. They are mainly physical exercises which do not require much mental effort and are beneficial in preventing stiffness in marching.

The exercises are arranged in homogeneous groups as follows :—

TABLE III.

Exercise	Table	Cadence	Cals. per sq. metre per hour
Slow March	5	70	132

Remarks.—The arms and hands to be kept steady at the sides, toes pointed downward and placed on the ground before the heel, each leg to be straightened as it comes to the front before the foot is placed on the ground.

TABLE IV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. H.f.—With Knee raising mark time. (Plate 1, fig. 3) ..	2	40	172
2. H.f.—With Knee raising march. (Plate 2, fig. 4) ..	4	40	182
3. H.f.—With Knee raising double mark time	4	140	383
4. H.f.—With Knee raising double march	7	140	466

Remarks.—The figure for No. 3 appears to be too low when compared with that of No. 4 which requires very little more muscular effort.

TABLE V.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Quick March. (Plate 1, fig. 1)	1	130	192
2. Quick March (Heels raise). (Plate 1, fig. 2)	1	130	235
3. Rapid March	3	140	333
4. Running on the spot	4	180	382
5. Double march. (Plate 4, fig. 10)	1	180	450

Remarks.—These exercises show the progression in expenditure which one would expect.

TABLE VI.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. H.f.—In quick time sideways march	3	112	219
2. H.f.—In double time sideways march	5	140	684

Remarks.—In the above exercises a pace of thirty inches is taken and they are done on the toes.

TABLE VII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Mark time with opposite Knee and Arm raising. (Plate 3, fig. 7)	1	88	256
2. Marching with opposite Knee and Arm raising	2	88	252
3. Hopping with opposite Knee and Arm raising. (Plate 4, fig. 9)	—	—	497

Remarks.—One would expect a slightly higher expenditure for the marching with opposite knee and arm raising than for the marking time.

TABLE VIII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. H.f.—On alternate Feet hop. (Plate 2, fig. 5) ..	3	104	457
2. On alternate Feet hop, with Arms raising sideways. (Plate 3, fig. 6)	5	104	517
3. On alternate Feet hop with Arms swinging upward ..	6	104	558

Remarks.—These exercises show a very high energy expenditure but this is considered to be correct as they require great muscular effort for their proper performance.

The figures approach the maximum for sustained effort as quoted by Cathcart and Benedict.

(II) *Introductory Exercises.*

These exercises are of varied types. They are not confined to any individual muscle group but rather embrace practically all the muscles of the body. They ensure good carriage and true balance, they improve muscular control, they arouse the attention of the class and, last but not least, they procure the "warming up" of the body to approximately 100·5° F., the physiological optimum temperature at which the muscles produce their best efforts.

The undermentioned groups are the homogeneous subdivisions of the Introductory Groups.

TABLE IX.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Small and large Arm swings	2	—	147
2. Small Arm swing with Feet placing sideways. (Plate 13, fig. 40)	4	—	135
3. Small and large Arm swings with Heels raising and Knees bending. (Plate 14, fig. 42)	5	—	329

Remarks.—The first two are easy rhythmical exercises which bring in co-ordination rather than effort. They certainly lower the mean energy expenditure value of the Introductory group in Tables 2 and 4. It is debatable whether their proper place might be in the Final rather than in the Introductory Group of Exercises. If they remain in their present group it is thought that "small arm swings with feet placing sideways" with an expenditure as low as 135 cals. might be placed in Table 3 instead of Table 4.

TABLE X.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. F.astr.A.l.c.—Arms fling from low cross to sideways stretch. (Plate 11, fig. 36)	4	—	179
2. A.l.c.—Heels raising with Arms flinging to flight. (Plate 12, fig. 38)	2	—	252
3. Heels raising and Knees bending with Arms forward raising, forward bending, flinging and lowering. (Plate 11, fig. 37)	3	—	324
4. A.l.c.—Heels raising and Knees bending with Arms flinging to flight. (Plate 12, fig. 39)	4	—	312

Remarks.—In this group No. 4 is more strenuous than No. 3 and it should have shown a greater energy expenditure if the proper amount of effort had been used in its performance.

TABLE XI.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. F.astr.H.f.—Trunk bending downwards (quickly). (Plate 42, fig. 100)	2	—	285
2. F.astr.Tr forw.b. — Floor beat with Knees straight. (Plate 43, fig. 103)	4	—	260
3. F.astr.Tr.forw.b.—Floor beat with Arms swinging backward, forward and upward (knees straight). (Plate 47, fig. 116)	5	—	289
4. F.astr.—Floor beat and Trunk stretching forward with neck rest (varied). (Plate 42, fig. 101)	6	—	318

Remarks.—In No. 2 the expenditure is too low. If the exercise is correctly performed a large amount of effort is required by big muscle groups.

TABLE XII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Hopping with Leg raising sideways. (Plate 7, fig. 18) ..	4	130	292
2. Hopping with Leg raising sideways, and opposite Arm raising to flight. (Plate 18, fig. 47)	6	130	355

Remarks.—In No. 1 an expenditure of 292 calories is too little. If properly performed it should show a much higher reading.

TABLE XIII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. H.f.—Hop with Toe placing sideways. (Plate 7, fig. 17)	1	96	366
2. H.f.—Hop with Toe placing forward. (Plate 7, fig. 17) ..	2	96	346
3. H.f.—Hop with Toe placing sideways and forward ..	3	96	357

Remarks.—The difference in these exercises is rather in co-ordination than in effort.

TABLE XIV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. H.f.—Astride jumping. (Plate 6, fig. 16)	1	130	400
2. Astride jumping with Arms raising sideways. (Plate 16, fig. 14)	2	130	397
3. Astride jumping with Hands clap above Head. (Plates 16 and 17, fig. 45)	5	130	418

Remarks.—The main expenditure in these exercises is in the jumping

and variation in the figures are much more likely to be caused by the amount of effort put into the jump than by the co-ordinated arm movements.

TABLE XV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Small jumps with single Arm stretching (various directions). (Plate 13, fig. 41)	2	140	417
2. Jumping with alternate Arm stretching (various directions). (Plate 13, fig. 41)	3	140	497
3. Small jumps with Arms stretching (various directions). (Plate 15, fig. 42)	6	140	456

Remarks.—These are good warming-up exercises and also stimulate nerve control in co-ordinating the arm movement.

The following five exercises cannot be grouped with any others and so are taken separately.

TABLE XVI.

Exercise	Table	Cadence	Cals. per sq. metre per hour
H.f.K. full b.—Jumping forward, sideways and backward ..	6	—	432

Remarks.—There is no set cadence for this exercise as it cannot be included in any of the other groups. It is an exercise which needs a great amount of both effort and control.

TABLE XVII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
F.astr. one Hand H.f.—Arm circling. (Plate 10, fig. 34) ..	1	—	283

Remarks.—This exercise promotes looseness of the shoulder joint and generally tones up all the shoulder-girdle muscles.

TABLE XVIII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
F.astr.Tr.forw.b.—Arms swinging backward, forward and upward. (Plate 10, fig. 35)	2	—	281

Remarks.—A good exercise for loosening the shoulders.

TABLE XIX.

Exercise	Table	Cadence	Cals. per sq. metre per hour
F.astr.—Trunk twisting with alternate Arms flinging. (Plate 29, fig. 71)	3	—	281

TABLE XX.

Exercise	Table	Cadence	Cals. per sq. metre per hour
High kicking at Hand (taken free)	5	—	307

Remarks.—Promotes looseness of hip-joint and stretches ham strings.

GENERAL EXERCISES.

These form the real working part of the table, during which frequent short rests are given. They are put early in the tables, after the Intro-

ductory Exercises, as the muscles are still fresh and at their physiological optimum temperature for work. They are divided into Heaving, Lateral, Balance, Abdominal, and Dorsal exercises.

(III) *Heaving Exercises.*

These require powerful action of the arm and back muscles and are put first in the list with the temperature and condition of the muscles at their best. As a great many of these exercises need apparatus for their performance only a part of the class would perform them at a time so the average temperature of the class would have come down a little at the end. They are sub-divided into the following homogeneous groups:—

TABLE XXI.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Arch hanging. (Plate 20, fig. 50)	1	—	119
2. Arch hanging.—Arms bend. (Do.)	2	—	199

Remarks.—The position in "arch hanging" is an exercise in itself. The shoulder girdle should be well braced so as to throw the weight of the body on to the extensor muscles of the scapula.

TABLE XXII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Fall hang. (Plate 19, fig. 49)	2	—	131
2. Fall hang.—Arms bend. (Do.)	3	—	210

Remarks.—Here as in the foregoing group the position also constitutes an exercise, progression being obtained in the "arms bend."

TABLE XXIII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
Arms stretching forward, sideways, upward and downward. (Plate 9, figs. 31, 29 and 30)	1	—	160

Remarks.—A free standing exercise which develops the muscles of the shoulder-girdle.

TABLE XXIV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Overgrip. (Plate 20, fig. 51)	3	—	141
2. Overgrip.—Arms bend. (Do.)	3	—	282
3. Crossgrip. (Plate 22, fig. 53)	3	—	172
4. Crossgrip.—Arms bend. (Do.)	3	—	242
5. Oblique grip. (Plate 22, fig. 53)	4	—	161
6. Oblique grip.—Arms bend. (Do.)	4	—	297
7. Undergrip. (Plate 21, fig. 52, *a*, *b*, *c* and *d*)	4	—	195
8. Undergrip.—Arms bend. (Do.)	4	—	285

Remarks.—All these exercises need only show progression in their "arms bend." The mean expenditure of this group is more than that of the preceding ones. When hanging from the beam the body should be well braced, the head slightly back and the chin drawn in.

TABLE XXV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Climbing (with hands and feet). (Plate 24, fig. 58) ..	3	—	326
2. Climbing. Down Hand under Hand (without use of Feet). (Do.)	4, 5 and 6	—	305
3. Climbing Hand over Hand (without use of Feet). (Plate 25, fig. 59)	7	—	424

Remarks.—In No. 2 the reading is too low. Three experiments were carried out on this exercise, the readings being 269, 327 and 355 calories respectively. In the first experiment he came down too quickly and did not check properly between each hand. The reading was therefore less than it should have been. If the first experiment is ignored the mean of the other two would have been 341 calories per square metre of body surface per hour, which figure is much nearer the mark.

It will be noted that in the progression of this group the strain is thrown on to the heaving muscles alone when the "feet assisting" is omitted.

Note.—The samples in these exercises were taken over a period covering both ascent and descent of rope.

TABLE XXVI.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Overgrip.—Side travelling changing grip. (Plate 22, fig. 55)	5	—	245
2. Overgrip.—Side travelling with swing. (Plate 23, fig. 56)	6	—	232

Remarks.—These two exercises are much more strenuous on the muscle group concerned than the energy expenditure would suggest, as the whole weight of the body and the bracing of it into proper position is borne by the heaving group of one side while grips are being changed.

TABLE XXVII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Undergrip.—Upward circling (beam head height). (Plate 23, fig. 57)	5	—	262
2. Undergrip.—Upward circling (beam stretch height). (Do.)	—	—	—

Remarks.—In these exercises the first part is abdominal and the second heaving. With the beam head height a certain amount of help can be obtained by the push off the floor.

TABLE XXVIII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
Mounting shelf (with assistance). (Plate 26, figs. 60 to 64) ..	6	—	329

Remarks.—The sample was collected throughout the whole exercise.

(IV) *Lateral Exercises.*

These exercises chiefly turn the trunk and bend it sideways, increasing the flexibility of the spine and the mobility of the chest. They counterbalance any tendency to one-sided development due to games or manual labour. The muscles chiefly affected are the side muscles of the trunk, the

adductors, abductors and rotators of the thigh. The muscles of the spine and front of the trunk are also employed, and the exercises have consequently a close relationship to the "Dorsal" and "Abdominal" groups, especially the latter.

This group particularly well illustrates how progression is obtained by fixing the pelvis and then throwing practically all the effort on to one group of muscles. This is not always shown in the calorie expenditure which is an indicator of general rather than local metabolic change. Progression is also obtained by raising the centre of gravity (by changing the position of the arms) thereby increasing the leverage, and by increasing the speed with which an exercise is performed.

The group is sub-divided into the following homogeneous groups:—

TABLE XXIX.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. F.astr. H.f.—Trunk bending from side to side. (Plate 28, fig. 68)	1	—	183
2. Trunk bending from side to side (quickly). (Do.) ..	4	—	219

Remarks.—These exercises are done with a sweeping movement with an extra effort at the end of each bend.

The output for the second exercise does not appear to be high enough taking into consideration that it is done quickly.

TABLE XXX.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. F.astr. one Hand H.f.—Trunk twist and single Arm fling. (Plate 29, fig. 71)	1	—	215
2. Sit. pos.—Trunk twisting with single Arm flinging. (Plate 31, fig. 73)	5	—	207
3. On Hands and Knees.—Trunk twisting with single Arm flinging. (Plates 30, 31, fig. 72)	6	—	240

Remarks.—The progression in these three exercises is better illustrated by the fixation of the pelvis with the consequent localization of effort and strain than in the calorie expenditure.

TABLE XXXI.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. F.cl. one A.b. one Hand H.f.—Trunk bending sideways with Arm stretching upward	2	—	134
2. S. position. —Trunk bending sideways (quickly). (Plate 28, fig. 69)	2	—	209
3. On K., L.(R) L.sidew. str. Hands on Head.—Trunk bending sideways. (Plate 28, fig. 69)	3 and 4	—	170
4. H.f., F.support.—Trunk bending sideways	4	—	215
5. One A. upw.str. One Hand H.f. Foot support.—Trunk bending sideways	5	—	204
6. H. support, one A.upw.str. One Hand H.f.—Trunk bending sideways (Beam)	6	—	125

Remarks.—In No. 1 the expenditure of 134 calories is much too low. It should have shown progression on trunk bending from side to side (see Table XXIX) as the centre of gravity has been raised, whereas it shows a

drop of 49 calories. Here also, as in Table XXIX, the benefit derived from and the energy expended in the exercise are directly proportional to the amount of effort exerted to get the extra little bit at the end of the swing.

In No. 2 the leverage is increased by the position of the raised arm, thus increasing the effort necessary for its performance. The energy expenditure value of 209 calories appears far too low.

No. 3 shows the low expenditure of 170 calories. This exercise does show progression on the foregoing two in that the starting position fixes the pelvis and also places the centre of gravity higher. The fixing of the pelvis tends to localize the effect to the particular muscle group and one does not get that compensatory muscular action which is required to fix the pelvis when this exercise is performed standing. Even allowing for this it is still thought that the calorie expenditure is low.

No. 6 shows very low energy output but progression has been obtained by fixing the pelvis.

TABLE XXXII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. On the Hands on ground.—On the Left (Right) Hand turn, Leg raising. (Plate 32, fig. 74)	3	—	184
2. Ditto. At wall bars, the Free Hand grasping the highest bar that can be reached in line with the other Hand. (Do.)	3	—	206

(V) *Balance Exercises.*

These exercises employ a large number of muscles, but require little actual strength. They require very accurate co-ordination of movement and consequently have an excellent effect on the brain and nerves. They cultivate power of control over the body and limbs, overcome stiffness and awkwardness, give an easy carriage to the body, and make the movement free and well ordered. They also instil nerve into the soldier and accustom him to moderate height.

Progression in the free standing balance exercises is effected by reducing the base on which the body is supported and by raising the centre of gravity of the body by altering the position of the arms from H.f. to A.upw. str.; in the exercises on apparatus it is effected by increasing the height above the ground at which they are performed.

TABLE XXXIII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. H.f.—Knee raise. (Plate 34, fig. 78)	1	—	90
2. H.f., K.r.—Leg stretching forward and backward. (Plate 34, fig. 78 and Plate 34, fig. 79)..	3	—	120
3. H.f., K.r.—Leg stretching forward, sideways and backward. (Do., do.)	4	—	127
4. A.b., K.r.—Leg and Arm stretching (various directions)	5	—	158

Remarks.—The progression here is accompanied by increased energy output throughout.

TABLE XXXIV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. H.f.—Leg raising sideways. (Plate 34, fig. 79)	1	—	100
2. H.f.—Leg raising sideways and backward. (Do.) ..	2	—	102
3. H.f.—Leg raising forward, sideways and backward. (Plate 34, figs. 78 and 79)	3	—	115
4. Leg raising forward with Arm raising upward	5	—	126
5. Leg raising forward, sideways and backward with Arm raising forward, sideways and upward..	6	—	123

Remarks.—These exercises illustrate progression in both co-ordination and effort.

TABLE XXXV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Walking backward and forward on benches (laid side by side)	2	—	106
2. Mounting beam (Knee height)	3	—	186
3. Mounting beam (Knee height). Turning about.. ..	3	—	182
4. Mount with Foot assisting, walking forward and downward jumping (Beam waist height). (Plate 36, fig. 82) ..	4	—	208
5. Mount with Foot assisting, walking forward and backward (Beam waist height)..	5	—	174
6. Mount with Foot assisting, walking forward (Beam shoulder height)	6	—	236

Remarks.—In these exercises the energy output is no criterion of the stage of progression.

(*To be continued.*)

AN INVESTIGATION INTO THE BACTERIAL POLLUTION OF SWIMMING BATHS.

With special reference to:—

(1) The normal bacterial flora, the pathogenic organisms present and their importance in relation to the spread of disease.

(2) The viability of certain micro-organisms, chiefly of the coli-typhoid-dysentery group, in fresh-water and sea-water.

(3) A study as to the presence of bacteriophage in fresh, sea, and sea-bath waters.

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(*Continued from p.* 351, *vol. lx.*)

Section III.

RESULTS OF AN INVESTIGATION TO DETERMINE THE PRESENCE OF BACTERIOPHAGE IN ORDINARY TAP-WATER, SEA-WATER AND THE WATER FROM SEA-WATER BATHING POOLS AFTER USE.

It will have been noted that earlier in this paper attention was directed to the following facts which were apparent from the results of bacterial counts at various stages after use of sea-water bathing pools :—

(1) That sea-water as such showed a low bacterial count.

(2) That for the first few days after use of fresh sea-water in baths the counts rose and then showed a definite fall, irrespective of the fact that large numbers of additional bathers used the same water.

There appeared to be two possible explanations of this fact, namely : (1) That the number of bacteria primarily introduced multiplied, then died out naturally as time progressed ; or (2) that there was produced in the bathing water some substance which was inimical to the growth of bacteria in the water, or which was at any rate actually deleterious to the organisms, and probably as a result of some lytic action caused the destruction of these organisms.

Following on the work of Twort and D'Herelle, it seemed possible that this substance might be of the nature of a bacteriophage, and therefore a series of experiments was made with a view to determining whether or not any bacteriophage was to be found in sea-bath water. At the same time, investigations were carried out with natural sea-water taken from the sea itself and not from tanks. Tap-water was also investigated.

Another reason why the following series of experiments was carried out was that the possibility of the presence of a bacteriophage in water had

been demonstrated by the work of other writers. Certain waters have a definite bactericidal action on particular organisms, and one possible explanation of this would appear to be the presence of a bacteriophage in these waters.

The following examples of waters that have bactericidal action have been described :—

(1) Arloing and Sempé (1924) state that the water of the Saone inhibits the growth of *Bacterium coli,* but not of *Bact. typhosum.*

(2) The water of the Isère inhibits the growth of *Bact. paratyphosum* A ; the Rhone, *Bact. typhosum.*

(3) The sea at Havre inhibits the growth of *Bact. shigæ* (according to Arloing and Chavanne (1925), Arloing and Sempé (1926)).

(4) In India the water of the Ganges is said to inhibit the cholera vibrio.

Several methods were used, of which the following are the chief :—

Prior to the commencement of any experimental work on the actual waters ultimately investigated, cultures of the following organisms were prepared : (1) *Staphylococcus albus* ; (2) *Staph. aureus* ; (3) Pneumococcus Type II ; (4) *Streptococcus hæmolyticus* ; (5) *Bact. coli communis* ; (6) *Bact. typhosum* ; (7) *Bact. paratyphosum* B ; (8) *Bact. dysenteriæ,* Flexner ; (9) *Bact. dysenteriæ,* Sonne ; (10) *Bact. dysenteriæ,* Shiga.

The next step taken was to test these young cultures against a definite known bacteriophage specific for the organism, in order to establish the fact that the actual strains used were not resistant to the action of a bacteriophage, should one be found.

In all cases it was found that the strains were non-resistant and showed a definite result when the specific organism was duly tested against its own bacteriophage.

Method of Filtration.—The apparatus used is shown in the photograph. The following method was adopted in all the series of experiments about to be described wherever it was desired to produce a filtrate free from organisms.

A glass container A, complete with the filter candle which was passed through a tightly-fitting rubber cork C, and which was kept in position by a screw, was sterilized by being autoclaved for one hour. At the same time, the flask D was sterilized for the same length of time.

Prior to use, the piece of rubber-tubing E was also sterilized thoroughly by boiling.

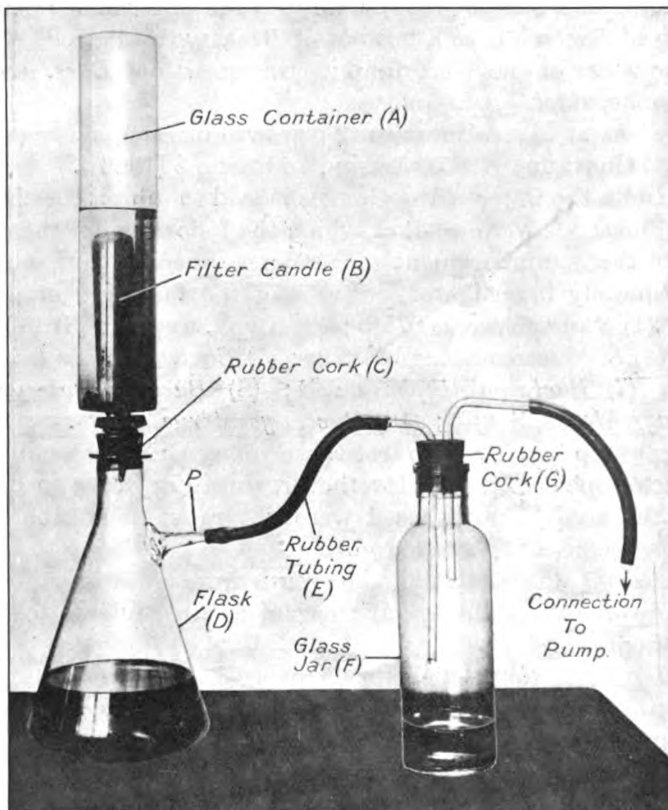
This piece of tubing was connected to glass tubing which passed through a tightly-fitting rubber cork fixed into the mouth of the glass jar F. Another piece of glass tubing also passed through this cork and was connected by a piece of rubber tubing to a pump attached to the water-tap.

When all these things had been sterilized and assembled, the contents of the flask to be filtered were poured slowly into the glass container A and the tap turned on.

The flow of water was carefully watched to see that there was no chance

of any flow back into the glass jar F, and that a steady suction action was maintained on the flask D.

Prior to the commencement of the filtration, a number of cotton-wool stoppers of suitable size for plugging the mouth of the flask and also the end of the piece of glass-tube projecting from the flask at P were sterilized.



When the whole of the contents of the flask had been filtered, the rubber tubing at P and the glass container A were disconnected, and these two points were closed with the sterilized cotton-wool stoppers. The filtrate was then tested for sterility, and if found sterile was used in the routine experiments about to be described.

The following methods were employed in the actual experiments :—

First Method.—To quantities of 50 cubic centimetres of sterile broth in flasks were added 10 cubic centimetres of each of the three water samples to be tested for bacteriophage. These flasks were incubated at 37° C. for twenty-four hours. After incubation, the contents of the flasks were filtered through a bacterial filter (L. 7) in order to remove the organisms. Plates of media best suited to the growth of the specific

organisms were then inoculated with a pure young culture of the organism by the following method: Three drops of sterile broth were placed on the plates of media, and the specific organisms from the young cultures were emulsified into this with a platinum loop. Three drops of the broth filtrate, prepared as above, were now added to the plates. The plates were then spread with a sterile spreader—a separate spreader being used in each case. This was done with each water sample. The plates were incubated for twenty-four hours, and at the end of that period they were examined for evidence of the presence of any bacteriophage.

By this method seventy-five samples of tap-water, sea-bath water and ordinary sea-water respectively were examined against each of the ten specific organisms over a period of five and a half months. In no case was evidence of the presence of bacteriophage obtained.

Second Method.—The same ten organisms were again employed in the form of young (twenty-four hour) slope cultures. To three 50 cubic centimetres broth flasks were added with sterile pipettes 10 cubic centimetres of each of the waters to be tested, and these were incubated for twenty-four hours at 37° C. Next day the contents were filtered through a bacterial filter (L. 7) in order to remove the organisms present. Slopes of the appropriate media were now inoculated with the specific organisms for which bacteriophage might be present in the sample waters. A medium sized platinum loopful of the filtrate from the broth flask was then drawn down the centre of each inoculated slope. These cultures of the specific organisms which had been treated in the centre with the filtrate were incubated at 37° C. for twenty-four hours, and at the end of this period were examined. (As no sign of any bacteriophage was present they were further incubated for seven days and examined at the end of each twenty-four hour period).

By this method a further fifty experiments were carried out for presence of any bacteriophage in tap-water, sea-water and sea-bath water. In all these cases the results were negative.

Third Method.—Young cultures of the ten organisms were again prepared on their appropriate media. Three lots of ten broth tubes were inoculated, each with one of the specific organisms noted above. Three 50 cubic centimetre flasks of broth were inoculated with 10 cubic centimetres of tap-water, sea-water and sea-bath water respectively and incubated at 37° C. for twenty-four hours. At the end of this period the contents of the flasks were filtered through a bacterial filter (L. 7) to remove organisms, and the filtrate kept in sterile flasks. 0·5 cubic centimetre of the young broth cultures of the organism was now added separately to ten sterile broth tubes, and to each tube was added 0·5 cubic centimetre of the filtrate to be tested. These tubes were then incubated for twenty-four hours and examined at the end of that period. Controls consisting of tubes of broth to which were added 0·5 cubic centimetre of the young broth cultures of the specific organisms without any filtrate were also incubated.

At the end of twenty-four hours all the tubes were examined and the following two points noted.

(1) Whether, as might have been expected if bacteriophage was present, the "test" tubes were entirely clear of any growth.

(2) Or whether the growth in these tubes was distinctly less than in the control tubes to which no filtrate was added.

In addition the following further test was made :—

From the tubes to which both organisms and filtrate had been added 0·1 cubic centimetre of the contents was plated out on agar plates and counted for total number of bacteria. These results were compared with the counts on plates made by adding 0·1 cubic centimetre from the control tubes to which no filtrate had been added.

In all thirty-five experiments were carried out by this method, each experiment including samples of tap-water, sea-water and sea-bath water ; each water was tested against the ten specific organisms employed, with the following results.

(1) In no case were the culture plates found to be sterile on examination the following day.

(2) In no case was there any appreciable difference between the tubes containing organisms + bacteriophage and the control tubes as to the density of the growth produced. The counts made from the tubes containing organisms plus filtrate and the control tubes containing the organisms only gave approximately the same results.

By this method no evidence was obtained of the presence in tap-water, sea-water or sea-bath water of bacteriophage against the test organisms employed.

Fourth Method.—Three 50 cubic centimetre flasks of broth were prepared and to these were added 10 cubic centimetres of tap-water, sea-water and sea-bath water respectively. These flasks were incubated for twenty-four hours at 37° C. and at the end of that period the contents were filtered through a bacterial filter (L. 7) to remove the organisms, and the filtrates collected under sterile conditions in the sterile flasks. These filtrates were then tested for the presence of bacteriophage as follows :—

Four tubes of broth were prepared for each of the ten specific organisms—making forty tubes in all for the samples to be examined of tap-water, sea-water and sea-bath water. Each series of four tubes was now inoculated with each specific organism to be tested.

Each series of the four inoculated broth tubes was then treated as follows :—

To tube 1 was added 1 drop of the filtrate to be tested.

To tube 2 was added 10 drops of the filtrate to be tested.

To tube 3 was added 2 cubic centimetres of the filtrate to be tested.

Tube 4 contained the organisms alone and was used as a control.

In this way the whole series of 30 lots of 4 tubes was prepared, namely :

10 lots of 3 tubes containing an organism + tap-water filtrate and 10 control tubes.

10 lots of 3 tubes containing an organism + sea-water filtrate and 10 control tubes.

10 lots of 3 tubes containing an organism + sea-bath water filtrate and 10 control tubes.

All these tubes were now incubated at 37° C. and at the end of eighteen to twenty-four hours were examined to see whether :—

(1) All the three tubes were turbid as well as the control tube.

(2) One or two tubes alone were turbid and the others clear—with turbidity in the control tube.

(3) All the first three tubes were clear with turbidity in the control tube.

Twenty different specimens of tap-water, sea-water, and sea-bath water were examined by this method, involving the preparation of a series of 20 sets of 120 tubes.

In every case it was found that so far as the naked eye could judge, there was no appreciable difference in the turbidity of the emulsion of the organisms in any of any series of three tubes when compared with the control.

So that again by the adoption of this fourth method the same result had been obtained as by other methods, namely that there was no sign whatever of the presence in either tap-water, sea-water or sea-bath water of bacteriophage active against any of these ten specific organisms.

The fact that in this last series of experiments the first three tubes were all turbid and showed no visible difference from the control tubes in the density of the emulsion is not absolute proof of the absence of bacteriophage. According to D'Herelle it does not follow that there is no active bacteriophage present because complete lysis of the bacteria does not take place. Therefore the series of tubes from each experiment were subjected to the following tests to see whether, when a definite quantity of the emulsion from these tubes was plated out on agar-plates, any abnormal appearances developed, such as: (*a*) Some part or the whole of individual colonies having a clear or glassy appearance; (*b*) the colonies showing any sign of a bitten or nibbled appearance ; (*c*) the presence, on plates with a confluent growth, of clear, circular areas showing no growths—the *taches vierges* of French observers, the *löcher* of the German workers.

For the purpose, therefore, of these experiments 0·1 cubic centimetre of the separate broth emulsions was spread over agar plates by means of sterile spreaders. These plates were incubated at 37° C. for twenty-four hours, and at the end of this period were examined for signs of the presence of bacteriophage against any of the specific organisms used. In all cases the plates showed a uniform growth of the organism from each of the first three tubes which differed in no respect from agar plates prepared from the fourth tube in each series which contained broth and organisms only, and were control tubes.

This further series of experiments therefore confirmed in all respects the original findings from the first experiments, namely, that neither in tap-water, sea-water nor sea-bath water after use, could any trace of the

presence of a bacteriophage against the organisms be found, even after twenty complete investigations of each type of sample.

Fifth Method.—Ten tubes of sterile broth were inoculated, each with one of the above-mentioned organisms. Three series of such tubes were prepared for testing the filtrates of the samples of tap-water, sea-water, and sea-bath water (after use) respectively.

To three 50 cubic centimetre flasks of sterile broth were added respectively 10 cubic centimetres of tap-water, 10 cubic centimetres of sea-water, and 10 cubic centimetres of sea-bath water (after use). These flasks were incubated for twenty-four hours at 37° C.

At the end of this period the contents of each flask were filtered under pressure through a bacterial filter (L. 7) and the filtrate collected in sterile flasks; the filtrate was tested as to its freedom from organisms.

The three series of ten tubes referred to above were now placed in the incubator at 37° C., and incubated for five hours until they showed definite signs of turbidity. At the end of this period there was added to each tube 0·5 cubic centimetre of the filtrate to be tested, i.e., to one series the filtrate from the tap-water, to the second series the filtrate from the sea-water, and to the third series the filtrate from the bath-water after use.

At the same time as the original broth tubes and organisms were prepared, a series was also prepared to act as controls, and to these was added no filtrate, and they were incubated also for five hours.

The whole series of these tubes, including the controls, was now further incubated until the following morning—approximately fifteen to eighteen hours, and were then examined.

In this way twenty samples of each water were tested.

Results.—In all cases there were no signs whatever of any of the tubes containing organisms and filtrate showing a clear fluid on the following morning, nor was there any difference to the naked eye in the density of the emulsion between the tubes containing organisms and filtrate and the control tubes. This finding was confirmed by plating out 0·1 cubic centimetre from each tube on to agar plates, and also 0·1 cubic centimetre from the control tubes; none of the plates from the tubes containing organisms and filtrate showed any signs of the presence of a bacteriophage. The growth on these plates was uniform and similar to that on the plates prepared from the control tubes, and isolated colonies on the plates were quite normal. So once again by this method also no signs whatever were found of a bacteriophage in either tap-water, sea-water or sea-bath water active against any of the ten specific organisms employed.

Sixth Method.—The method described under the fourth method was employed with the following modifications:—

The ten tubes of broth were prepared and sterilized—one for each of the specific organisms. Three sets of ten were thus prepared, making forty tubes for each sample to be examined of tap-water, sea-water and sea-bath water after use, the fourth set being a control series. Each series of tubes was now inoculated with the specific organism to be tested.

Instead of adding 10 cubic centimetres of the raw water in this experiment to 50 cubic centimetres of broth and incubating it at 37° C. for twenty-four hours, a sample of the water itself was filtered under sterile conditions by the method described earlier in the text through an L.7 filter, and the filtrate put into the sterile flasks.

Each series of four inoculated broth tubes mentioned above was then treated as follows:—

To tube 1 was added 1 drop of the water filtrate.

To tube 2 was added 10 drops of the water filtrate.

To tube 3 was added 2 cubic centimetres of the water filtrate.

Tube 4 contained the organism alone and was used as a control.

From this point the method adopted was essentially the same as that described under the fourth method, including the confirmatory tests. Ten experiments were conducted by this method with each kind of water, and in no case was any trace of any bacteriophage found.

Seventh Method.—An attempt was made in this method to enhance any bacteriophage present in the water by the addition of the organism to the water whose bacteriophage it was desired to demonstrate. This method was employed only in the case of the sea-bath water after use.

Ten tubes of sea-bath water were taken, and to each was added one of the specific organisms to be tested. These tubes were then incubated at 37° C. for forty-eight hours, and at the end of that period the contents were filtered through an L.7 bacterial filter and the sterile filtrates collected.

Young agar slopes of the ten specific organisms were then inoculated from the stock cultures, proved non-resistant to their specific bacteriophage, and incubated at 37° C. for twenty-four hours.

Plates of media suitable for the optimum growth of the specific organisms were also prepared. Each plate was inoculated with three drops of sterile broth into which was emulsified a loopful of the specific organism from the young cultures, and then three drops of the filtrate to be tested was added. These plates were then incubated at 37° C. for twenty-four hours, and examined and re-examined at the end of forty-eight hours.

Fifteen experiments were carried out by this method, and in no case did the plates reveal any trace of bacteriophage.

Conclusion.

There is not present in either tap-water, sea-water or sea-bath water (after use) any demonstrable bacteriophage against any of the above-mentioned organisms.

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PERCAINE SPINAL ANÆSTHESIA.

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This note on a short series of cases is submitted in the hope that others who have employed this form of anæsthesia may criticize the observations I have made and give in turn details of their own experiences.

It would be interesting to know whether percaine is affected by storage in a tropical climate.

The simplicity of administration, the certainty of the required stage of anæsthesia, the absence of risk to the patient both during operation and afterwards, and the absence of any after ill-effects as shown in the cases observed, lead me to anticipate a very great increase in the general employment of this anæsthetic by medical officers of the Services.

The "one-man" operation is now possible, for the surgeon can be at the same time anæsthetist, instrument-clerk and dresser. This should be of great importance to medical officers in the smaller stations at home, but more especially abroad where expert assistance by anæsthetists is sometimes not obtainable.

Dozens of abdominal operations have been performed with this anæsthetic by a surgeon without the presence of another medical officer.

It is always advisable, however, that, when possible, another medical officer should be present in case his assistance is required, either in the performance of the operation or in giving general anæsthesia to assist the spinal anæsthesia.

Abdominal emergencies, in which the risk to life is increased by delay or by a general anæsthetic administered without experience, can be safely dealt with by any medical officer having this anæsthetic in his possession and some knowledge of its administration.

During the past twelve months I have made fairly constant use of percaine for inducing anæsthesia by spinal injection. Out of a total of 283 operations, 117 have been performed successfully with this anæsthetic.

Though percaine can be used for intra-abdominal operations or other operations below the level of the ninth intercostal space, it may be contra-indicated for the following reasons :—

(1) The patient may be too ill to permit of his being turned about as required in the administration of percaine. (2) There may be evidence of shock to contra-indicate use of percaine. (3) Patients may be extremely nervous or excitable, and may show considerable mental reaction to spinal puncture both during the operation and afterwards, although they feel no pain and the premedication has been given as usual.

Before employing this anæsthetic I heard many adverse criticisms as to its ill-effects, such as : (1) Severe headache lasting for weeks and completely

prostrating the patients; (2) the frequency of chest complications; (3) cramps and aching pains in the back and lower limbs.

I found that headache was present in a few cases operated on in the first two or three months of this series. It was never severe, but in at least two instances was present intermittently up to the twenty-first day after operation. With the modified technique now employed, "spinal headache" and pains in the back have not been encountered for the past six months.

Chest complications have been entirely absent except in those cases showing signs of bronchial infection at the time of operation. In fact, the presence of chest signs and symptoms is an indication for the employment of this method of anæsthesia, provided the surgical condition permits. There were no other ill after-effects whatever.

In four cases only there was apparent failure to produce anæsthesia. Two of these in the earlier part of the series were undoubtedly due to the fact that the needle had made a valve-like opening in the dura which permitted the cerebrospinal fluid to escape, and when the percaine was injected it went extradurally.

In the other two cases, which were dealt with during extremely cold weather, anæsthesia came on one to two hours after the operation had been completed in one case under general and in the other under local anæsthesia.

When percaine fails, or when the anæsthesia is not sufficiently high (as found in some operations in the upper abdomen), the question of what form of anæsthetic to give as an alternative is not yet decided. Perhaps local anæsthesia with novocain by itself or with the aid of light open chloroform and ether mixture is the best. As the premedication does not include atropin, the administration of unaided ether mixtures to the required stage of anæsthesia may be difficult. There is also a risk of post-anæsthetic pulmonary infection. In the event of percaine anæsthesia being delayed, it may be found that this has supervened during the course of the operation which has been continued under a general anæsthetic. In any case, it is better to defer operation in such cases for at least half an hour to allow the fullest time for percaine to take effect. In the meantime, another case can be dealt with. When it is found that the percaine anæsthesia has not reached a sufficiently high level, as sometimes happens in dealing with the stomach, gall-bladder, etc., light general anæsthesia by ether and chloroform mixture has been found very safe and efficient.

At times the skin incision must be extended upwards, and while the intra-abdominal organs are quite insensible to pain it may be found that the upper end of the skin wound is quite sensitive. In these cases novocain locally injected meets the difficulty.

Great care must be exercised to determine the difference between (*a*) Anæsthesia proper; (*b*) persistence of sense of passive movement; (*c*) power of active movement.

Active movement of the lower limbs may persist long after the required degree of anæsthesia has been produced, even as high as the tenth

intercostal region. The sense of passive movement, which the patient describes as "pushing and pulling," may persist throughout.

The following is the method of administration now employed :—

(1) The systolic blood-pressure is recorded.

(2) Pre-medication. A hypodermic injection of alopon $\frac{1}{3}$ grain and scopolamine $\frac{1}{150}$ grain is given three-quarters of an hour before spinal puncture. The patient is left at rest and quiet for this time, and although the drowsiness and sleep normally found to supervene after the anæsthetic is effective do not show earlier, this rest period has a very good effect on the general condition of the patient both during and after the operation.

(3) The systolic blood-pressure is recorded immediately before spinal puncture. This is compared with the clinical signs of intradural pressure of cerebrospinal fluid as shown by the rate of flow when the needle is introduced.

(4) After a hypodermic injection of half a cubic centimetre of 2 per cent novocain spinal puncture is made at the chosen level with the patient lying on the side opposite to that on which the site of operation is to be performed. For operations in the upper abdomen the first and second lumbar space has been found quite satisfactory. The best site for operations in the lower abdomen is the second and third lumbar space. For operations on the rectum and lower limbs the third and fourth lumbar space is found most convenient.

(5) The cerebrospinal fluid is allowed to escape until the flow is a slow drip (one per second). If there is any tinge of blood when the drip has reached this rate, it is better to withdraw the needle and puncture in the space next above. The needle is turned once or twice during this preliminary flow of fluid to ensure that it is actually within the dura.

(6) Percaine which has been previously heated to 37° C. is then injected. The quantity has been roughly estimated according to the height of the patient.

5 feet to 5 feet 4 inches	..	..	14 cubic centimetres
5 feet 4 inches to 5 ,, 8 ,,	..	..	16 ,, ,,
5 ,, 8 ,, to 5 ,, 10 ,,	..	..	18 ,, ,,
5 ,, 10 ,, to 6 ,,	..	..	20 ,, ,,

When cases show undue excitement or are of a nervous or neurotic tendency, an extra cubic centimetre is added to the above table.

(7) Ephedrine 1 cubic centimetre is injected hypodermically immediately the spinal needle is withdrawn.

(8) The patient is then turned on his face, care being taken to keep the head not higher than horizontal with the spine.

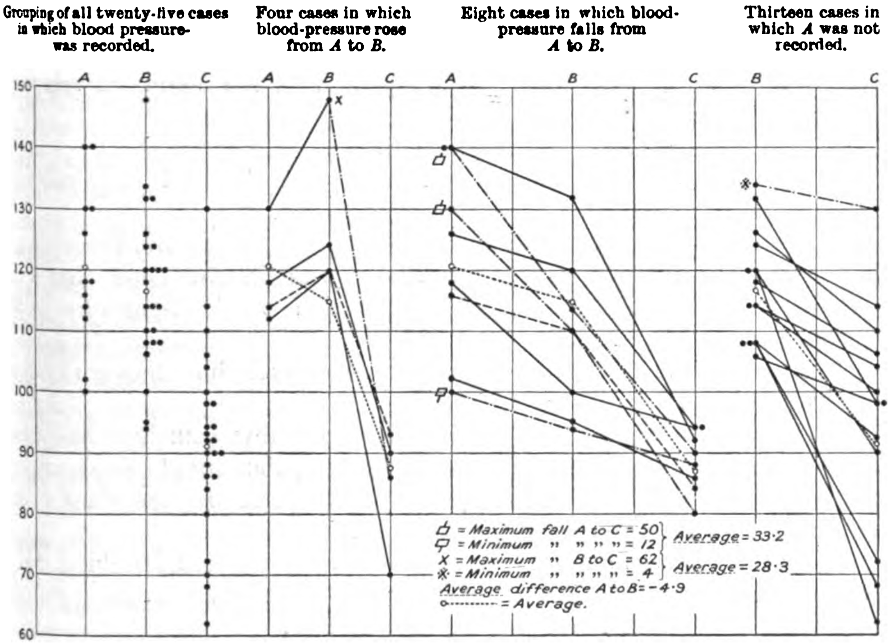
(9) Systolic blood-pressure is recorded five minutes after the spinal injection is completed.

It is found that satisfactory anæsthesia is produced in seven to ten minutes after spinal injection.

The warming of the percaine has been introduced with the idea of combating shock and in the belief that the action is quicker and more diffuse than with a cold solution.

Ephedrine to sustain the blood-pressure is a doubtful aid—from the records of blood-pressures in the last twenty-five cases the fall in blood-pressure has been pretty constant, and in a few cases alarmingly great. When the fall exceeds 36 millimetres, the patient becomes very cyanosed and respiration is very shallow and slow. The pulse-rate has not been found to be affected in any marked degree nor have any ill after-effects been observed.

The table of blood-pressures, although from only a few cases dealt with by me this year, is recorded for what it is worth. The greatest fall in blood-pressure from normal after spinal injection was 50 millimetres in two cases. Several instances of falls of 42-48 millimetres were recorded. The minimum fall was 12 millimetres; the average was 33·2 millimetres.



A = Normal systolic blood-pressure. *B* = Systolic blood-pressure at the end of premedication. *C* = Systolic blood-pressure after percaine.

The variation from normal up to the end of premedication was not constant. In roughly one-third of the cases there was a rise, in others a slight fall; the average fall was 12·1 millimetres; the average difference was 4·9 millimetres. The marked fall is from the end of premedication to the completion of the spinal injection of percaine; the greatest fall recorded being 62 millimetres and the least 4 millimetres, with an average of 28·3 millimetres. As there were no instances of "spinal headache"

since these pressures were recorded methodically no inferences could be drawn, except that the greater or smaller the fall did not seem to bear any direct relation to the causation of headache.

In all cases the urine is tested as a routine measure the day before operation. The injections of ephedrine are continued at eight hours, twenty-four hours, and thirty-six hours after operation.

Headache may be due to the blood-pressure remaining abnormally low for twenty-four hours after operation.

The vexed question of when to allow the head to be raised still remains to be answered; it has been my custom to allow patients to sit up as soon as the effects of the anæsthesia have completely disappeared, after six to eight hours, normally.

The most important points which have been noted and the improvements in the technique which have been made during the period covered by this note are :—

(1) Pre-operative quiet for three-quarters of an hour to promote a feeling of ease, mental rest and confidence.

(2) Drainage of cerebrospinal fluid until the intradural pressure is somewhat below normal, before the injection of the comparatively large quantity of percaine.

(3) Warming of the percaine solution.

(4) Absence of risk of headache if the patient's head is raised after effects of anæsthesia have completely disappeared.

(5) The methodical recording of blood-pressures at the three stages. This will be carried out throughout the year in the hope that some evidence may be obtained as to the relation of blood-pressure to the incidence of headache.

To sum up, this method of promoting anæsthesia has shown no serious drawback or risk.

There have been no ill-effects other than a few transient headaches. The complete relaxation found when performing abdominal operations very greatly assists in the ease with which these operations are effected, and greatly reduces the time expended on them.

The patient experiences no distress from vomiting and coughing, which are such common troubles after the administration of a general anæsthetic even when given with the greatest skill and care.

The fact that he can have a hot drink of tea and smoke a cigarette as soon as he returns to bed has a very consoling and comforting effect both on him and other candidates for surgical interference waiting in the wards.

Lastly, the surgeon has complete confidence that once anæsthesia is effected, there will be no *contretemps* or delays arising from the anæsthetic.

I believe that where surgical conditions permit and when the services of a really experienced anæsthetist are not available, this form of anæsthesia is much preferable to any form of general anæsthesia or other forms of spinal anæsthesia of which I have had experience.

PERCAINE SPINAL ANÆSTHESIA.

By Major K. P. MACKENZIE,
Royal Army Medical Corps,
AND
Captain J. M. PINKERTON, M.C.,
Royal Army Medical Corps (*T.C.*).

Percaine spinal anæsthesia has been used by one of the joint authors (J.M.P.) as a routine for all operations below the diaphragm for the past two years. When the other joint author (K.P.M.), recently returned from India, had seen this form of anæsthesia employed in a variety of cases he recognized its great value to Service medical officers, especially in the tropics.

By means of the alopon-scopolamine-percaine anæsthesia described in this article, the long suffering surgical specialists in India can, at last, be released from the necessity of having to hunt for an anæsthetist when about to perform a difficult abdominal operation.

Percaine, known in America as nupercain, is a quinoline derivative and belongs to a group chemically quite distinct from cocaine. It is a hydrochloride of alpha-butyloxycinchoninic acid diethylethylenediamide which is readily soluble in water and alcohol. The anæsthetic potency is about ten times greater than cocaine and about twenty times greater than novocain so that it may be used in very dilute solutions. The anæsthetic properties of this drug were discovered only four years ago.

The method of producing anæsthesia is approximately that described by Dr. Howard Jones. The patient is prepared for operation in the way which is now customary, i.e., with as little disturbance, purgatives, etc., beforehand as possible. Three-quarters of an hour before operation a hypodermic injection of alopon-scopolamine is given according to age. By the time the patient arrives in the theatre he is drowsy or in an amnesic state and, on account of basal narcosis, not acutely sensitive to pain. The patient is placed on the operating table in the right or left lateral position with the spine fully flexed by drawing the knees up to the chin. The side to be operated upon is kept uppermost. The level of the iliac crests is marked with an iodine swab and the lower dorso-lumbar spinous region is painted with iodine. A hypodermic syringe containing one cubic centimetre of two per cent novocain is used partly to make a weal on the skin at the site of the proposed percaine injection; the remainder is injected into the track along which the spinal needle will travel. After two or three minutes the percaine solution is injected intrathecally as follows: a twenty cubic centimetre record syringe and a very fine steel or all nickel needle not more than 1·2 millimetres bore, with a short bevel, of the Howard Jones pattern, about nine cubic millimetres long, are required. An ordinary

lumbar puncture needle which fits the syringe will serve the purpose in emergency. The syringe and needle should have been boiled in water free from alkali. The percaine solution is warmed to blood heat by immersing the ampoule in warm water, and then opened. Twenty cubic centimetre ampoules of dilute hypobaric percaine 1/1500 solution are used. The syringe and needles are washed out with a small quantity of the percaine before the syringe is finally charged with the amount to be injected. The site of the lumbar puncture and the amount of percaine solution used vary according to the nature of the proposed operation, but the method employed is the same in all cases. The fine steel needle, without stilette, is introduced into the centre of the selected lumbar interspinous space and pushed slowly but steadily onwards, keeping the point strictly in the middle line of the body and giving it a slight inclination upwards towards the head. In a normal case the needle will encounter resistance, first from the interspinous ligament, next from the very tough ligamentum subflavum and finally from the dura mater after which the point will be felt to be free. After passing on for another millimetre or so the progress of the needle should be arrested; if the point lies within the spinal theca cerebrospinal fluid will appear and drip very slowly from the needle. Sometimes, however, the needle will encounter bone instead of the ligamentum subflavum; in such a case it must be withdrawn considerably, until the point is quite free from the interspinous ligament, and once again pushed forwards with a slightly different inclination. With the very fine and flexible needle used it is useless to attempt to alter the inclination of the point while this is grasped by the firm and unyielding interspinous ligament. As soon as it is certain that the point is within the theca the twenty cubic centimentre syringe is attached to the needle, which is carefully held in position, and the percaine solution slowly injected. The greatest care is taken to prevent the loss of more than one or two drops of cerebrospinal fluid. As soon as the injection has been made the syringe and needle are withdrawn and the puncture sealed with collodion wool. An intramuscular injection of ephedrine, three-quarters of a grain, in one cubic centimetre of fluid is made into the buttock and the patient rolled over into the position of ventral decubitus with the head low and the table tilted slightly in the Trendelenberg position. He is kept thus for a period of not less than five minutes, in order to allow the percaine, which is lighter than the cerebrospinal fluid, to soak the posterior (sensory) roots. At the end of this period the patient is rolled over on his back (dorsal decubitus), care being taken that the head is not raised. By the time the towels are arranged and the skin over the operation area prepared, which usually takes about five more minutes, the anterior root effect (muscular paralysis) will generally be complete.

To those officers of the Corps who have had experience in venereal departments the method of direct injection of hypobaric solution of dilute percaine into the subarachnoid space should present no difficulty.

Ordinary lumbar puncture needles can be used, but the finer needles as recommended by Dr. Howard Jones are preferable, as very few cases of spinal headache occur after their use.

Owing to its low toxicity in dilute solutions there is no need to be sparing with 1/1500 hypobaric percaine solution so long as the dose of 18 cubic centimetres is not exceeded. Women need less than men. Dr. Howard Jones recommends that the dosage should be regulated according to the length of the spine measurement, taken from the seventh cervical spine to the level of the inter-cristal line. For men this length in inches, less four, gives the amount in cubic centimetres of percaine solution required for an abdominal operation; thus, if the spine measured 21 inches, 17 cubic centimetres of the percaine solution would be required. For women it is recommended that the dose should be 2 cubic centimetres less. This gives a reasonable basis for trial, but with experience a larger or smaller dose is given according to the level of the analgesia desired. We are not altogether convinced that the length of spine should be the deciding factor, but are guided by the size and weight of the patient and the level of anæsthesia required.

For the guidance of those who wish to try this form of anæsthesia we suggest the following dosage and site of injection which we have arrived at as the result of experience. (The smaller figure is for a small man, say 5 feet 2 inches in height and 8 stone in weight; the larger figure for a big man, say 5 feet 10 inches in height and 12 stone in weight.)

For a high abdominal operation sixteen to eighteen cubic centimetres injected into the first or second lumbar interspace, i.e., between the first and second or between the second and third lumbar vertebræ.

For a lower abdominal, subumbilical operation, fourteen to sixteen cubic centimetres are injected into the third or fourth lumbar interspace.

For an operation in the hernia or the anal region or on a lower limb twelve to fourteen cubic centimetres are injected into the fourth lumbar interspace.

Exceptionally small and exceptionally large men would require a cubic centimetre less or more than the figures given. For women the dose would be two cubic centimetres less in each case.

Management of the Case.

Before commencing the operation the following tests of a satisfactory anæsthesia should be made :—

(1) Ask the patient to raise the legs. He is unable to do so.

(2) Ask the patient to raise the thorax off the table. He is unable to do so.

(3) Ask the patient to cough. A difficult or ineffectual effort is made.

(4) Pinch the skin several inches above the level of the proposed operation area with a towel clip. There is no sensation.

Throughout the operation the head should be kept lower than the trunk.

Occasional sponging of the lips or the administration of smelling salts is refreshing and stimulates the respiration. At intervals the patient is ordered to take in six to ten deep respirations: this improves the colour and helps the lung expansion. Many patients find it a relief to talk a little, and by keeping them awake the danger of anoxæmia from deficient ventilation of the lung is reduced.

If scialytic lamp reflectors, reflecting glass roofs or the glass fronts of instrument cupboards, should be within the range of the patient's vision in the theatre his eyes should be covered. The pulse and respiration and the patient's colour should be carefully watched, especially towards the end of a long operation, as, owing to the anterior root effect some of the patient's intercostal nerves are out of action, so the diaphragm has to carry on alone, hence the tendency to anoxæmia as well as respiratory depression due to basal narcosis. In cases of appreciable anoxæmia oxygen and carbon dioxide should be given immediately until the colour improves.

We find that the maximum fall in blood-pressure is reached about twenty minutes after spinal injection, but when ephedrine has been given the fall is slight and transient.

On return to the ward the patient, when awake, is made to take in several deep respirations every hour or so. After the patient has left the theatre there is complete absence of physical restlessness, and time is given thereby to sleep off the effects of the narcotic and analgesics.

After-treatment.

Patients are returned to the ward as quickly as possible and are given a cup of hot tea and ten grains of aspirin. The foot of the bed is raised about ten inches off the ground and remains raised for twenty-four hours. No pillow is allowed for forty-eight hours. In cases of vomiting, alkaline drinks or cold water with sodium bicarbonate, thirty grains to the pint are given *ad lib.* A fluid diet with custard is given for the first twenty-four to forty-eight hours, thereafter a gradual return to ordinary diet is made. An aperient is given forty-eight hours after operation in most cases.

Immediate Results and Possible Complications.

(1) Analgesia. Within a few seconds after the injection the patient experiences a pins and needles sensation, or a prickly warmth in the feet. This advances rapidly upwards as a zone over the legs, thighs and abdomen, and is followed by surgical analgesia, and, in a favourable case, complete anæsthesia and muscular paralysis in the operation area. The surgical anæsthesia lasts for at least three hours and possibly for five, sufficient time for the longest operation. After this, sensation begins to return, but will not be complete for ten or twelve hours after injection.

(2) Fall in blood-pressure. This occurs as in other forms of spinal anæsthesia. It is due to vaso-motor paralysis, but is not nearly so great

as with large doses of novocain or stovain, and is generally at its maximum twenty minutes after the injection.

(3) Nausea and, very rarely, vomiting may occur in the nervous type of patient, apart from any intra-abdominal manipulations, but these will generally yield rapidly to treatment by suggestion. As the vagus and phrenic nerves are both outside the range of spinal anæsthesia, properly administered, traction on the stomach and mesenteries may also give rise to nausea and even vomiting if not done gently and with discretion. To prevent this a small dose of nitrous oxide and oxygen suffices to tide the patient over this part of the operation; but it is not essential, as one of us has performed many operations on the stomach and upper abdomen without any adjuvant to the percaine anæsthesia.

(4) Respiratory failure or embarrassment. This is not a phrenic motor paralysis but really an intercostal nerve paralysis due to the anterior root effect of the hypobaric solution on the patient in the dorsal decubitus. Here the diaphragm has to carry on by itself with the result that lung expansion takes place chiefly in the lower lobes. A vicious cycle is established due to imperfect lung ventilation resulting in anoxæmia with fatigue of the respiratory centre and shallow breathing, plus the depression caused by preliminary narcotics.

In the unlikely event of respiratory failure or severe respiratory embarrassment, which has not occurred in our experience, it would be necessary to perform artificial respiration and to keep it up for a considerable time.

Remote After-effects.

(1) Headache. This has always been regarded as the most frequent and serious after-effect of all forms of spinal injection analgesia. We find that the incidence of headache after percaine injection is very much less frequent with the technique we now employ, and it is rarely that any patient complains of really severe or prolonged headache. Before the present routine was followed there were a few cases of severe headache lasting in one case for a week. We attribute the comparative freedom from headache to (*a*) not dehydrating the patient prior to operation by drastic purgatives; (*b*) the use of a small-bore needle for spinal puncture; (*c*) the greatest care being taken to prevent the loss of cerebrospinal fluid, or the spread of percaine to the higher sensory roots; (*d*) routine post-operative care already referred to.

(2) Bronchitis. This was a fairly frequent sequel in the earlier cases, but is now rare because of the routine efforts to secure proper ventilation of the lungs during and after operation. We also take great pains to prevent chill during transfer from the theatre to the ward after operation. Cases showing the slightest signs of bronchitis prior to operation are put on stimulant expectorants for two or three days before and after operation.

(3) Hiccough. This has been said to occur sometimes after gastro-enterostomy and we have had a case after colectomy in which there was some local peritonitis.

(4) Squint. One case occurred in our series, three weeks after operation and lasted a month, but made a complete recovery.

(5) Deafness ... .. (6) Traumatic tabes ... (7) Persistent paraplegia	None of these occurred in our series.

Limits of the Method.

Although there is a considerable distance between the fourth and fifth cervical and the fourth dorsal roots, as a margin of safety we think that operations above the distribution of the fourth dorsal roots should not be undertaken with this method of analgesia. Also the fact that the solution is hypobaric precludes the use of the reversed Trendelenburg position during operations and makes it undesirable to put the patient up in the Fowler position immediately after operation. In cases of acute peritonitis the Fowler position must be used, but if at all possible the patient should be kept flat and on the affected side for six hours after operation. For cases of known peritonitis hyperbaric concentrated 1/200 percaine should be used, after which the Fowler position can be used at once. Percaine should only be employed when the heart and circulation are sound.

Drugs Used.

(*a*) Azoule brand ampoules of alopon $\frac{2}{3}$ grain with scopolamine $\frac{1}{150}$ grain (Messrs. Allen and Hanbury's) for the preliminary injection.

(*b*) Percaine hypobaric solution of 1/1500 in 20 cubic centimetre ampoules, as supplied by the Clayton Aniline Co. Ltd., Pharmaceutical Dept., 40, Southwark Street, London.

(*c*) Ephedrine sulphate $\frac{3}{4}$ grain ampoules in 1 cubic centimetre as made by Messrs. Burgoyne Burbidges and Co., Ltd., East Ham, London, E.

Points in Favour of the Method.

(1) Absolute painlessness. Complete muscular relaxation. The muscular relaxation is more perfect than that obtained by any other form of anæsthesia; this has proved most valuable in cases of abdominal distension associated with obstruction, where a very deep anæsthesia by inhalational methods would be required at the risk of endangering the patient.

(2) Sensory fibres are more easily affected than motor.

(3) Analgesia always extends higher than paralysis.

(4) The long duration of analgesia is helpful after operation, as it secures freedom from pain for several hours after.

(5) High dilution of the percaine prevents too rapid absorption of the drug.

DOWN SOUTH.

By U. P. A.

II.—To Adam's Bridge.

(*Continued from p.* 266, *vol. lx.*)

A man and his wife who proceed on three months' leave, and whose itinerary includes several big cities within the tropical zone, require a good deal of baggage which is both heavy and bulky—even when (as in our case) everything was rigorously cut down. If you travel in Europe, you need not carry towels and bedding. If you trek in Kashmir, you and your wife do not want special clothes for race meetings, or for dining out. In a tour such as this one, the easy course is to send the heavier baggage on ahead by rail; but this entails a fixed programme as regards places and dates, and that is an arrangement which neither Georgina nor I can abide. So we carried everything with us, and our big six-cylinder tourer was crammed to bursting point. Georgina produced a brilliant solution of the bedding problem, which, so far as we know, is original. Towels, sheets, nets, rugs, and blankets—spread flat—a camp mattress and two pillows, were packed into a khaki drill envelope which sat on top of the hood. The interior of the car was thereby relieved of a very bulky package, and we were provided with excellent protection against the heat and glare of the sun. For various reasons I much dislike a rear luggage carrier unless it forms part and parcel of the original design of the car; but we had an expanding fitment which, when screwed on to one of the running boards, took a goodly assortment of the lighter articles. A brother-officer kindly offered us an ice-box which it was intended to fasten to the other running board; but unfortunately it was heavy and too broad, and, when fixed, the doors of the body could not be opened. As the expanding rack closed the doors on the other side, it is evident that, when the car was fully laden, it would be impossible to enter it or leave it, except by "going over the top." To this Georgina objected—not on the score of physical disability, but because she considered that we ought not to perform acrobatics before an audience composed of Café and Noir: bad for discipline. In the end, the whole load comprised the following articles:—

Bedding envelope on top of the roof.

Motor accessories in a tin strapped to a rear buffer.

Hurricane lamp, "Flit" outfit, and two despatch cases on one running board.

We two, and the tiffin things, in front.

Café, Noir, two suit cases, canvas kit bag, hat box, small basket and the two servants' bundles, behind.

Fortunately it is not necessary to carry extra petrol in any part of India nowadays. Our tank held eight gallons, and the car did 22 m.p.g.

On a trip such as this there is seldom any difficulty—though there may be delay—in getting running repairs carried out; but if you wish to insure against loss of temper, misery and exhaustion, make certain that your tyres are up to the work. Old or worn tyres will not stand up to 200 m.p.d. over shocking surfaces when the temperature is 100° or more, and especially when the car is laden and running at speed. Finally, join your local automobile association. Naturally, it cannot give you as much or as efficient assistance as the A.A. or the R.A.C. can give you at home; but, in this tour, membership of the Western India A.A. proved a real benefit, which—through the agency of the Southern India and Ceylon A.A.s—continued from beginning to end.

Possibly all this is inexcusable. Probably it is intensely boring.

We all have our little ailments—muscular rheumatism or what not.

We have all sat in dentists' chairs and suffered the tortures of the damned.

We have all been employers of servants who were "the limit."

Most of us have been through an exceptional hot weather, the like of which had never before been known.

Few of us have not toured in automobiles, and fewer still have not inflicted the ego often, and persistently, on weary, woebegone ears.

I apologize.

Hot, grimy, and weary, our spirits rose as we sighted the oasis of Trichinopoly. Delightful visions of baths, changes of clothing and tea floated before our tired eyes.

We missed the by-pass into the cantonment, and wasted precious minutes in plunging about the narrow, stuffy, crowded streets of the native town.

On entering the compound of the dák bungalow, a wave of despair drowned the high hopes which we had foolishly conjured up and nurtured. Georgina wilted. My heart sank. Café and Noir regarded the scene with suspicion and dismay: they did not attempt to unload the car.

The compound wore a neglected air: it was dusty and unswept. The bungalow was bankrupt of self-respect: it was shabby and dirty. The dusky occupants, lounging in long chairs on the verandah, were clad in thin cotton sleeveless vests and dhotis. A good deal of brick-red betel juice had been expectorated to the four points of the compass: fresh or dried, it is æsthetically offensive. The members of the staff, with some hangers-on, formed a group which looked like an anti-Bolshevik propaganda poster: a villainous, miserable, unclean crowd.

A glance was enough for Georgina. "We cannot stay here," she declared, with conviction.

As my command of language was inadequate, I said nothing: but I tried to convey my disgust in looks. No one seemed to be much impressed: they were case-hardened. A nasty, low-caste fellow detached himself from

the group and reeled towards us. He was heavily doped. He rolled his bloodshot eyes, clutched at nothing with his grimy paws and swayed. He frothed at the mouth and his articulation was paretic. He said he was the dâk bungalow butler—a statement which made Café and Noir laugh aloud: I had to rebuke them. He also said—with difficulty—that he had received my letter, and had taken it to the butler of the M.E.S. inspection bungalow.

This was great news indeed!

Another hooligan, who was less intoxicated than the alleged d.b. butler, mounted the running board and guided us to the fort. He wanted to accompany us inside the gates, but I gave him four annas and a push.

The exterior of this fort seemed strangely familiar: high mud walls with loopholes and parapets but no windows, and pierced by a single big gateway. On entering, we were filled with surprise and delight, for we realized at once that we were in the safe custody of an old friend. There was a big parade ground bounded by barracks, offices and stores, which were built against the inner faces of the perimeter walls. There were stables, a few trees and one or two plots bright with flowers. Order and cleanliness, peace and quiet reigned everywhere. There was nothing artistic about the scene: indeed, it was ugly; but it was British to the core and a welcome sight for sair een. It was just as if a magic carpet had suddenly transported us to the fort at Peshawar or Kohat. I felt that at any moment we might hear a rattle of arms and see a smart Piffer guard turn out to greet us—but now there are few troops in Trichy. However, there are still two or three good fellows in the fort—caretakers and the like—who make your interests theirs, for they are obviously ex-members of the good old pre-War army. They and their families, and the band of the S.I.Ry.Bn. (A.F.I.) are the sole occupants of the fort to-day.

The bandmaster—a typical old soldier wearing a long string of ribbons: ex-Devon Regt.—told us that our letter had arrived in time to obtain the sanction of G. E., Madras. He conducted us to the M.E.S. inspection bungalow, and remained until he was sure that all arrangements met with our approval. It was a small thing; but it was one of those small things one notices, and remembers.

This bungalow was as clean as a new pin, and most comfortable. The butler looked after us just as well as if he had been in our service for twenty years. He was a servant of the old-fashioned type whose lightest form of address was an impressive "Huzoor!" and whose tea was infused with water which was really and freshly at boiling point.

Long live the G.E., Madras!

Do not make the mistake of thinking that, in devoting space to these apparently trivial matters, I have lost all sense of proportion. So many of us spend long years in India, and so many of us travel on leave or duty by motor car in out-of-the-way places, that the question of board and lodging en route is anything but trivial; it is vital. The deterioration of

dâk bungalows is a serious thing. Residence in many of them is fraught with danger to health; and it must be remembered that in no sense are they under military control. Hence, the existence of M.E.S. inspection bungalows is a great blessing; and the privilege of occupying them is one to be thankful for. Disappearance of these M.E.S. bungalows would mean that certain places could never be visited, either on leave or duty, without the aid of a caravan trailer. But surely life is already sufficiently complicated without the addition of a trailer. Would it not be better to revert to the bullock cart and double-ply tent of our grandfathers' days? Certainly it would be more healthy and restful; and a little hiking might prove the salvation of these pampered striplings, Café and Noir.

Trichinopoly, of cigar fame, is pleasantly situated on the River Canvery. To the north rise the Pachaimalai Hills, and to the south stretches the plain of Pudukkottai State.

In the Franco-British wars of 1749-63, the town was beseiged by Chanda Sahib, the Maharattas and the French. It was to draw off a part of this beseiging force that Clive—then an officer of the Trichinopoly garrison—made his famous dash on Arcot. His manœuvre succeeded in raising the siege.

A second determined siege was defeated by Major Lawrence.

Trichinopoly Rock is a striking feature of the place. It is a dominating mass of gneiss, rising 273 feet above the plain. On it is perched a temple to Siva and, on the summit, a smaller temple dedicated to Ganpati.

At the foot of the rock is a beautiful tank, with a graceful island pavilion in the centre, and near by is the nawab's old palace which now houses the Government courts and offices.

Trichinopoly has always been a great missionary centre. The R.C. community alone probably numbers over 10,000, and here is the residence of the Vicar-Apostolic of Madura. There are also several big Protestant missions. Bishop Heber, while on a visit from Calcutta, died here in 1826, and was buried in St. John's Church.

The population contains a large proportion of the Kallar, or thief, caste, and the place is—or was—a choukidars' paradise.

From all this it will be gathered that Trichy is a veritable museum of objects, animate and inanimate.

Next morning we were off bright and early, although, at the start, we were delayed for a minute or two. The old butler had been generously rewarded for his good offices: in return he put up a long and earnest prayer on behalf of our health, safety, prosperity and happiness, and we had to stay to hear it through.

On this day the scenery and the people recalled the India of our childhood.

Long service in the north had half-convinced us that the India of our picture books, children's magazines and mission services was a fraud

without either humour or sense: that it simply did not exist outside the imaginations of our wicked preceptors. However, that conviction had been weakening for some days, and now it altogether disappeared, for we were in the very midst of the India of Southern Hinduism. Here the sun is hot, but not fierce: the trees are mostly waving palms, and giants of the forest are rare in the plain country: the sacred places are angular and elaborately graven instead of sinuously graceful and austere: the men are small, wiry and dark, or bulky, shaven and olive-skinned; and the women are smiling, purdah-free and clad in gay colours.

How different from the Punjab and the Frontier!

Soon after leaving Trichy we ran south for about sixty miles, over indifferent roads, through Pudukkottai State. This State covers an area of 1,100 square miles of somewhat bleak and undeveloped country. Pudukkottai, in the middle of the State, is the one town of any importance in the whole area. This, the capital, is exceptionally clean, airy and well built. For long the reigning prince has been known as the Rajah Tondaman (Tamil for a "ruler.") The Tondaman family identified itself with the British interest during the siege of Trichinopoly in 1753 and, since then, has remained consistently and actively loyal.

On emerging from the State the road, turning south-west, leads via Tiruppattar to Madura, where we arrived at noon, after having covered 95 miles.

The district of Madura is bounded on the west by the spurs of the ghats, notably the Palni Hills, where is situated the delightful hill station of Kodaikanal, about 70 miles from Madura. Until this district passed to the British in 1801, it was the scene of constant warfare between the Maharattas and Mahommedans.

The town is situated on the river Vaigai, and in its immediate vicinity rises the Anamalai or Elephant Rock, the Pasumalai or Cow Hill and the sacred Skandamalai. From time immemorial this town has been both the political and religious capital of the extreme south. In consequence, it is full of interest. However, when you are hot, grimy and thirsty, your own creature comforts come before Indian religions and politics. We made for the dâk bungalow and—we drooped on its dilapidated doorstep: it was a wretched caravanserai, and the room reserved for Europeans was occupied. So, too, were the rest rooms at the railway station. The prospect of spending the night on the dâk bungalow verandah was more healthy than inviting, for on to this verandah opened many rooms, each of which was occupied by one or more Indians. However, the situation was saved by the people in the reserved room moving out, and by 4 p.m. we were able to take possession. Georgina regained her wonted cheerfulness, although the room was small, and apparently designed for a single traveller—also small. The bathroom was a mere cupboard, dirty and disreputable. Still, the meals were excellent, and the butler did his utmost to make us

comfortable. He had been in the service of an officer of the I.M.S. for over twenty-eight years.

While Georgina was bearing the brunt of these domestic difficulties, I was attempting to fight a non-co-operation conspiracy at the railway station. This is what happened :—

1 p.m.—Arrived at the station for the purpose of entraining the car. First babu regrets inability to accept; must have twenty-four hours prior notice. Show him copy of letter written to station-master fourteen days ago. First babu grunts and tells second babu to make out ticket. Second babu says that ticket forms are locked up in office safe, of which station-master has key. Station-master will not return from tiffin till 3 p.m. Politely but firmly declare my intention of remaining in the office till the ticket is handed over. Dispose myself accordingly, and in such a way that first babu is cramped, second babu is crowded out and third babu finds it difficult to spit in safety. Fourth babu, whose chair I have commandeered, suggests I would be more comfortable sitting on the platform or in the refreshment room. I agree, and intimate my resolve to study the view from the platform—with aid of a glass of beer—*after* the ticket has been produced.

Invasion of office by a mob of shunters, signalmen, porters, greasers, coolies, tonga drivers and spectators. Excitement, noise (Tamil), over-crowding, heat, stench. Black Hole of Calcutta. Hell. Am centre of interest. Take off my coat (having first emptied the pockets), roll up my sleeves and light a cigarette. Third babu in office says smoking in office is forbidden. Thank him, and draw his attention to notice on wall re penalties attendant on spitting. Non-official members of mob delighted : third babu goes out for breath of fresh air and to remove betel quid. First babu addresses mob. Implores. Argues. Cajoles. Everybody addresses everybody else. Din (Tamil). First babu mounts table : upsets ink bottle : threatens to call in police. I back him up and send my car boy for constable. Omnes pray me not to send for constable, and second babu hurriedly produces ticket from a fold in his dhoti. Officials look gloomy. Non-officials lose interest. Mob melts. I run the car up the ramp. Doors of covered van locked, bolted and barred : very secure and strong. Door opener absent on three months' leave, getting married. Substitute is expected at 3 p.m. Constable arrives, hands me a note-book and requests me to make written complaint in detail. I tell him I have no time at present to write an article for the Journal, R.A.M.C. I say : "Beat 'em up, my boy : they are all 'burra badmash.'" Constable makes a mental note that I am a lunatic at large. I depart at 2.15 p.m.

3 p.m. Return. Substitute door opener not yet on duty. Local Shell Oil agent, working on tank truck near by, agrees that Madura is . . . and that everybody in it is . . . Am heartened by his conversation. Discover that S.O. agent wallowed in a trench in front of Cambrai early in '18. We agree that Madura railway station and staff are * * * * Feel

much better. Station-master still tiffining. His assistant tells me that, as goods train does not leave until 6 p.m., I have come too early. Depart at 4 p.m.

5 p.m. Return. Dy.-asst.-station-master tells me that, as train leaves 6 p.m., I have come too late. Last saw dy.-asst.-station-master proceeding at a hard gallop, in an ekka, to lodge a complaint somewhere or other. A touchy individual. Note an official council of war being held afar off. Council approaches and, with commendable skill and alacrity, opens the proximal doors of the covered van. Virtuous and triumphant, I entrain car Ticket inspector discovers that the tackle for fastening the car securely to the floor of the truck has been lost. Chief plate-layer is unable to close the distal doors of the vehicle. The tackle storekeeper and the door repairer have gone home for the night. Council agrees that the truck cannot possibly proceed by to-night's train. I am on point of surrendering—when third babu commits tactical error: having procured fresh betel quid, he expectorates at range of 7½ yards. Very fine shot: misses my boots by 2 inches, Had no intention of hitting my boots, but did mean to register an outer. Potential King's prizeman.

Aspersions cast on third babu's morals, ancestry and virility. Ditto re his paternal grandmother and maternal cousins who, it appears, are goats devoid of horns and hair. Council (less third babu) overjoyed. Opine that third babu is an owl in moult. Council (less third babu) in ecstasies. Third babu silent: green: swallows hard: betel quid goes down the wrong way; coughs: splutters: retires spluttering.

Important Personage appears, viz., station-master returned from tiffin. Tremendous excitement and noise (Tamil). Shout my sorrows into station-master's large-size ear. Request address of most expensive lawyer in Mudura, for purpose of bringing an action against railway company for breach of contract and wrongful detention. Propose to claim heavy damages. Station-master horrified: say—"But sāār, it is not fault of railway company. Damn oil tank truck arrived at 9 a.m. It should have been null and void by 11 a.m., but pipe line broke down, and it is being unloaded by hand. Doubtless job will be finish not before 9 p.m. Agent sahib say with much cursings job to go full speed astern till bloody finish. Sāār, I cannot do nothing in predicaments. I am poor man." "And what is all this to do with me?" "Impossible not to shunt your truck on to train till petrol truck is nonest. Same loop line, sāār."

Stroll across to tank truck. Resume Cambrai sector reminiscences. Declare I think I have met agent before (which is true). Discover his name is T——. Discover he is a cousin of an old friend of mine, a popular officer in the Corps who is also a T——. Oil truck vanishes within 5 minutes. Car truck is shunted on to train. Station-master accepts a cigarette. Multitude cheers. T—— and I revert to Cambrai. Iced beer. Return to Georgina at 7 p.m.

The story of the despatch of the car is not retailed for the purpose of self-glorification: we can all display a certain amount of bulldog determination, or long-eared obstinancy, when need arises. No: the story is presented as an example of historical parallel. The successful issue of the struggle was due to the prosaic fact that, in The War, part of my service was spent as an ambulance train and embarkation officer.

It is interesting to note the close resemblance between the railways of Southern Indian and those of Northern France.

Memory was further stimulated when Fate decreed that the counterpart of my dear old friend, Monsieur Edouard Pamplemousse, should appear on the scene. Ofttimes, in France, when I was on the point of pushing a Gallic railwayman under an engine or into a dock, Comrade Edouard would pop up from nowhere, to find that the moment was suitable for to create a little diversion innocent, since it was evident that the phlegm English was—temporarily, no doubt—consigned to the dark shadows.

Likewise it fell out at Madura where, on several occasions, Pundit Bolanath Shankarji dropped from the skies in the nick of time. True, old Pamplemousse was a jolly bourgeois with a great sense of humour and a hearty laugh, whereas B. Shankarji was grave, dignified and as pompous as a stage bishop; but as you were compelled to make fun with the one and induced to poke fun at the other, the net result of their entrances was the same.

Punditji was a Madrassi Brahmin. He was somewhat fleshy. His features would have been handsome had they not been so sensual. His expression was alert and intelligent, and his English perfect, but his otherwise faultless manners were marred by an assumption of proprietorship which was bound to evoke resentment in some minds and levity in others Thus, Georgina disliked the pundit the moment she saw him: "That man makes me shiver," she said. On the other hand, I thought he was a great find and particularly on discovering that he had never read of Mark Twain's famous encounter with the guide in Rome. Of course punditji was sufficiently astute to ignore Georgina's shiverings and my sallies, so he scored.

As befitted the senior cicerone of the great Madura Temple, Bolanath Shankarji was clad from head to foot in spotless white raiment, and was driven in an expensive automobile by a uniformed chauffeur. Also, he was attended by two acolytes. When this imposing equipage drew up at the dâk bugalow a few seconds after our arrival, I expected to meet, at the least, the D.G., M.S., Congress Volunteers.

On that day, from noon till 10.30 p.m., the pundit expended much energy and petrol running between Georgina at the d. b. and me at the railway station. It amazed him to think that Georgina insisted on supervising the cleansing of the room with cresol solution, when she might be inhaling the vapours of a hundred incense burners. It confounded him to watch me toil and sweat on a railhead ramp, when I ought to be pondering over higher and better things in the calm, cool atmosphere of the cloistered shrine.

Why hurry?

Of what account is the loss of one day?

Is it possible that a so noble lady and a so wise a gentleman can pass through Madura without visiting the so unique and magnificent temple—the most renowned and most sacred of all the temples in India?

Such a thing is quite inconceivable: utterly unheard of.

It is not possible.

Well, that sort of thing takes a deal of doing over a stretch of ten hours in the hot weather. Despite opposition and raillery, Pundit Bolanath Shankarji remained imperturbable, insistent and full of hope: a most creditable performance. To the temple authorities pundītji, his car and his minions must he worth many times their weight in gold.

As a matter of fact we were disappointed that our best laid schemes had gone agley, and so prevented us from visiting this temple; but, having been nurtured in the north, our disappointment was not acute: neither Georgina nor I care much for the Dravidian architecture of the Brahmins, and if you see one good example of Dravidian, you see the lot—if not in size, at least in type. To the ordinary sightseer as distinct from the expert, there is hardly any difference between the temples at Udaipur, Chitor or Gwalior. There is the same setting, the same design, the same marvellously detailed carvings and the same difficulty in seeing the wood for the trees. Then again, the Western mind is not always, or even often, able to appreciate this specialized form of architecture: we are not all Besants and Yeats-Browns. There is nothing eerie or repulsive in the Byzantinism of Westminster Cathedral or of the basilica of Sacré-Cœur in Montmartre; but a typical Hindu temple is always eerie and often repulsive; and the more you know about it, the more repulsive it is. Its counterpart is not to be found throughout the length and breadth of Europe. Why? Because Christianity and Mahommedanism are closely related, whereas Brahminism is a thing apart.

Most of us can visit the Taj and similar buildings time after time, and enjoy each visit; but few of us wish to visit a particular Hindu temple more than once. In the former case the visit is based on our Western conception of beauty: in the latter it is prompted by curiosity. Snakes, monkeys, elephants, lingams and bulls are all very well in their own spheres of influence, but the ordinary Englishman prefers to adorn his religious beliefs and sacred buildings with what are, in his eyes, higher and better things. To be sure, he may be wrong; but that is his attitude, and he is content to leave it at that and to re-visit the tomb of Salim Chisti for the nth time.

Madura was the capital of Tirumala Nayak, and it is to this powerful monarch that many of its architectural masterpieces are assigned, including the most important renovations in the precincts of the temple. Tirumala's palace (1623-1659)—a Hindu building with Saracen features—is the most

perfect secular relic in the Madras Presidency. Another notable structure is the Vasante, the reputed summer residence of the God Sundareswara.

The great temple is honoured by the personal presence of Siva, who, in Southern India, is worshipped to the practical exclusion of the other two members of the Hindu Trinity. The ground plan of the temple measures 847 × 744 feet, and the main building is surrounded by nine gopuras, one of which is 152 feet high. The hall of a thousand (actually 997) pillars is a striking feature; and the whole place is a museum of exotic sculpture and painting.

Early in the fourteenth century the Mussulman invaders tried to destroy the great pagoda, but, although much damage was done, the inner shrines escaped. Since then the Brahmins have carried out extensive repairs and alterations, not always to artistic advantage.

One of the greatest names associated with the history of Southern India is that of Robert de Nobilis. De Nobilis was a priest who, in 1606, obtained permission from his bishop to adopt the life and dress of a sadhu. He settled down in Madura and lived as an extreme, orthodox ascetic. He wore the usual simple saffron robe, but he displayed a Cross which hung suspended from his neck by three gold threads representing The Trinity and two silver threads symbolizing the body and soul of the Saviour. He told the people that he was not merely a Portuguese foreigner, but a guru from Rome meditating on God. His piety, self-denial and Christ-like qualities so appealed to the countryside that, on his death, it was computed that he had converted at least a million souls : a marvellous individual feat.

Robert de Nobilis was succeeded by another Portuguese, the aristocratic and learned John de Britto; and he, in turn, was followed by the scholarly Beschi, whose Tamil writings are regarded by native pundits as the high-water mark of their literature.

Thus did the Roman Catholic Church raise its missionary structure on a solid foundation—a wise thing to do in a land where caste means everything. So old and so penetrating is the tradition of caste that in Madura, from time immemorial, it has even extended to differentiation between the right hand and the left. The members of the right hand caste are Brahmims, and those of the left hand caste, artizan outcasts. A section of the latter are leather workers; but whereas the men belong to the left, the women are attached to the right. As a result, whenever a feud is in progress between the two castes, the wives of the leather workers refuse to have anything to do with their husbands. Modern Western civilization is not the only complicated social system in the world.

On the morning of March 13 we left the dâk bungalow for the railway station, Georgina and I in a "fitton-gharri" (1837) and Café and Noir in an ekka of the year One. Café and Noir, having become habituated to a luxury six-cylinder automobile, waxed facetious at the expense of the ekka driver whose good humour had to be restored by extra backsheesh.

An Indian railway station is an entertaining place. Its multitudinous sights, sounds and smells are fearful and wonderful, and often amusing. Georgina was captivated by the adroitness of a solemn-looking passenger, who, while reclining at full length on the seat of his compartment, raised and lowered his carriage window several times by using his left foot only. I was button-holed by a ticket examiner of the comic babu type. He was very voluble, and monopolized the conversation thus :—

"My god, sāār, you think crowd of what-nots? My god, no. When peoples go Rameswaram visits, my god, lakhs of them, crores, my god. I say 'go away : full up : come to-morrow.' They not listen, my god. They shout : Rameswaram ki jai !' loud, like that, and—my god—you not hold them back with million stitches in time. Many olds, many youngs, many sickus, some deads. No matter. Rameswaram, ki jai. All go helter skelter on damn rail-gharri ; my god, sāār, tikkut examiner he sickus too."

At 10.30 a.m. the train pulled out on its 115-mile journey south-eastwards to the terminus at Danuskodi. The railroad follows the course of the Vaigai River, traversing a flat, sandy country of no interest : monotony is the dominant note. But as we travelled south towards the coast, the temperature fell and a refreshing salt sea breeze reminded us of such pleasant things as the Mediterranean, and the Channel, and the Solent off Netley—with the ship's stem pointing up-stream, of course. The farther one is from home, the more entrancing it is to visualize the delights attendant on one's return.

Meals and a health inspection at Mandapam Camp helped to relieve the tedium of the journey. In the course of the inspection we were closely questioned, carefully scrutinized and asked to fill up various forms of such length and complexity as made it evident that, even in India's penultimate station, the reign of the babu endures, vested and vital. One of the forms was an undertaking to parade Café and Noir, periodically, before the chief health authority in Ceylon. However, before the train proceeded, the senior inspector hurried up with the glad tidings that our real identity had only just been discovered ; and that, under the circumstances, we need not parade Café and Noir unless they developed cholera or smallpox or something equally alarming. We were grateful for the favour, and gratified to find that one person, at least, attached some importance to our status and qualifications. After that, Georgina and the senior inspector became quite friendly, while I receded into the background. The guard—a tactful little man—blew his whistle and waved a green flag at the right time. Helped by the senior inspector, Georgina scrambled into the carriage, waved her hand and remarked that, contrary to her everyday experience, a man could be a doctor and a sportsman at one and the same time.

I studied the chapter in the guidebook headed : " Alternative Routes to and from Ceylon."

A series of sand dunes and bridges carries the railroad on to the island of Rameswaram, separating Palk Bay from the Gulf of Manaar. This

island measures 11 × 6 miles, is under the nominal rule of the Chief of Ramnad—the "Lord of the Causeway" (Adam's Bridge)—and is inhabited by the Brahmins and their followers who are on the pay lists of the temples.

Rameswaram contains one of the most venerated Hindu shrines in India. It is supposed to have been founded by Rama himself, and is mentioned in the celebrated *Ramayama*, in connection with Rama's journey to Ceylon in search of Sita.

The enclosure of the great temple or Coil measures 1,000 × 657 feet. The height of the main gateway is 100 feet, and of the Coil itself 120 feet. The colonnades are 4,000 feet in length, each side measuring 700 feet. (The longest English cathedral is 500 feet: St. Peter's, Rome, 700 feet.) The whole is a very fine example of Dravidian architecture and workmanship. It is unusually massive—some of the slabs in doors and ceilings are 40 feet long—and the pillared halls surrounding the inner shrine are unique.

It is said that the process of building occupied four centuries—from the fourteenth to the eighteenth. As one might expect, this accounts for many defects as well as beauties; and—as usual—the detail revealed on close inspection is more impressive than the distant view. But despite its beauty, the detail is often vulgar, and sometimes worse; and a modern and copious application of white, blue, green, red and yellow washes has not improved the artistic values of the place.

Soon after 4 p.m. we arrived at Danushkodi, the western end of Adam's Bridge.

(*To be continued.*)

Editorial.

SPINAL ANÆSTHESIA WITH PERCAINE.

(By Major-General J. W. West, C.M.G., C.B.E., K.H.S.)

During the past year there has been a marked revival of interest in the method of providing anæsthesia for surgical operations by means of intrathecal spinal injections.

In the Medical Service of the Army spinal anæsthesia was formerly very popular and many of our more senior officers will remember how when Mr. Barker of University College Hospital introduced his method of controlled spinal anæsthesia by means of a solution consisting of stovaine and glucose of a higher specific gravity than the cerebrospinal fluid, it was taken up by Major Spencer, the Professor of Military Surgery at the Royal Army Medical College, and large numbers of operations were performed at Queen Alexandra Military Hospital, Millbank, with this method, and later Major J. G. Houghton (now Colonel) toured India to demonstrate the technique.

This method was undoubtedly very successful and proved of the greatest assistance to many of our surgeons working in situations where a skilled anæsthetist for an inhalation method was not available. It served the writer well on many occasions in India and at sea where difficult abdominal operations have had to be undertaken practically single-handed.

Opinions differed as to the value of glucose stovaine solution as a means of nerve block to avoid the additional shock of an amputation or other major operation in a seriously wounded man. The marked drop in blood-pressure which so commonly follows the use of stovaine led many military surgeons to condemn its use in such cases. In spite of this strong body of opponents we frequently used the solution in conjunction with gas and oxygen or light ether anæsthesia in high amputations of the thigh and disarticulation at the hip when no marked fall in the blood-pressure occurred and the method was regarded as life saving.

The method had certain definite drawbacks. Severe and prolonged headache not uncommonly followed its employment, and although this was possibly due to the technique of its administration and not to the drug employed, yet it caused the method to be regarded unfavourably by many operators.

Surgeons hesitated to place the patient in the Trendelenburg position for fear of the too high spread of the anæsthesia, and few attempted upper abdomen operations with this technique.

From time to time many other drugs have been employed for spinal anæsthesia; novocain and a solution lighter than spinal fluid, to permit of the Trendelenburg position being used, were employed.

The recent introduction of percaine, a very powerful anæsthetic, which can be used in very dilute solutions and of which a comparatively large quantity can be introduced, has led to a marked revival of interest in spinal anæsthesia.

The credit for introducing this anæsthetic to the attention of the medical profession in this country is due to Dr. W. Howard Jones, senior anæsthetist to Charing Cross Hospital, and the methods of dosage and general technique so carefully worked out by him are generally adopted as the most satisfactory.

With the dilute solutions of percaine employed the fall in blood-pressure due to vasomotor paralysis is not nearly so great as with stovaine and novocain; it is claimed that this is due to the dilute solutions employed which render sudden absorption into the blood-stream impossible.

The experience of Army surgeons with percaine has been very satisfactory and the two papers printed in this issue of the Journal are in accordance with the results we have generally attained.

From the surgeons' point of view, the task of dealing with a difficult abdominal case is much simplified. The complete relaxation of the abdominal parietes and the quiet state of the bowel, which has no tendency to obtrude itself, make for speed at all stages of the operation and so are of direct benefit to the patient. Careful attention to detail is essential for success, and although percaine anæsthesia has been described as a one-man-method we consider that the patient should be supervised by an anæsthetist and that the onus should seldom be laid on the surgeon of carrying out a difficult operation and also of looking after the general condition of the patient.

The patient after he has been turned from a position of ventral decubitus to a dorsal position must be in a slight Trendelenburg position to avoid too high spread of the anæsthesia.

Care in the apparently minor details of the spinal puncture is also essential. The patient should be spared all pain by a preliminary infiltration with novocain of the spot chosen for puncture; and it is good practice to inject the dose of ephedrine into the tissues in the site thus anæsthetized. If this is carefully done, and the spinal puncture skilfully carried out with a suitable and really fine needle, the patient will be quite unaware that anything has taken place.

Undoubtedly this method of using the new drug percaine in comparatively large quantities of a dilute solution is a distinct advance on previous methods of procuring spinal anæsthesia and would appear to be the very best method we have at our command at present.

Local and spinal anæsthesia have never attained the same popularity or importance in this country as they have on the Continent of

Europe. The reasons for this are twofold. Up till now there have been practically no specialists in anæsthetics by inhalation methods on the Continent and surgeons have been driven to exploit other methods. In this country the administration of inhalation anæsthesia has been brought to a high state of perfection and the skilful administration of nitrous oxide and oxygen and the introduction of carbon dioxide combined with premedication with basal hypnotics have robbed general anæsthesia of much of its danger and many of the after-discomforts for the patient. In our teaching hospitals the necessity which exists for all medical students to administer a given number of general anæsthetics in order to obtain their certificates limits the use of spinal methods in these hospitals.

We have recently had the opportunity of seeing percaine employed by Professor Sebrechts at his clinic in Bruges, Belgium. Up till 1932 Professor Sebrechts was able to report that spinal anæsthesia had been employed in his clinic on more than 31,000 cases and in consequence he speaks with much authority on this subject.

During two days active operating on a wide variety of cases we did not see a single inhalation anæsthetic administered nor any arrangements for their administration in the operating rooms.

Complete and satisfactory surgical anæsthesia was provided by intrathecal injection of percaine, and in one case by extradural local block for a high thoracic operation. Professor Sebrechts has varied the method of administration considerably from the generally accepted methods employed in this country. He states that his reasons for doing so are that he has found there are two types of patient met with in practice, one is sensitive to spinal anæsthesia and the other is resistant. He points out that apart from a few general rules, which will be given below, it is often impossible to determine beforehand to which type a patient belongs. An hour before operation he gives an injection of scopolamine and morphia. If this injection renders the patient very sleepy he is regarded as "rachi sensible"; the dose of percaine is reduced and a subcutaneous injection of ephedrine is given.

If, on the other hand, the premedication has no calming effect on the patient he is regarded as "rachi resistant," and a larger dose of percaine is given and no ephedrine.

The method as demonstrated to us was shortly as follows:—

After preliminary anæsthetization of the skin with novocain the spinal puncture was carried out in the lateral position with a very fine nickel needle having no stilette. An injection of fifteen cubic centimetres of 1-1,500 solution of percaine was then made and the patient turned over on his face with the needle in position. A drop of fluid could be seen at the orifice of the needle, but none flowed over. The pulse was carefully observed; if it slowed down markedly an injection of ephedrine was given subcutaneously. In such cases Professor Sebrechts said the anæsthesia is always good. If the pulse did not slow down and the desired anæsthesia had not been

attained as ascertained by pinching the skin with forceps, a second injection of the same amount was made with the spinal needle and no ephedrine was given. Fifteen minutes were allowed to elapse before giving this second injection. If after a still further period of waiting anæsthesia was not complete, a third or further doses were given. In one case where a partial gastrectomy was performed seventy-five cubic centimetres of percaine solution were injected before the necessary anæsthesia was produced. No actual blood-pressure records were taken; Professor Sebrechts considers them unnecessary and disturbing to the patient.

The impression gathered from the appearance of cyanosis or pallor of these cases was that the blood-pressure must have been considerably lowered and bleeding was notably slight from the incised tissues. Great care was taken to ligature carefully all vascular points, and all operations were concluded by the injection over the surface of the cut tissues of "coagulin" to prevent oozing. Drainage was also freely employed.

To account for the different reactions to spinal anæsthesia Professor Sebrechts states that in a normal subject the parasympathetic and orthosympathetic systems are in perfect equilibrium. In the case of a patient sensitive to spinal anæsthesia the parasympathetic is very active, while amongst the resistants the orthosympathetic is predominant.

He does not consider that the anæsthesia is influenced by a nervous temperament and very nervous patients may be good subjects and also very bad.

Certain states do, however, have a marked influence. Pregnancy is one of these, and in cases of Cæsarean section it is essential to reduce the dose to avoid serious accidents. On the other hand, in a ruptured extra-uterine pregnancy where the patient is anæmic and blood-pressure very low, while it is necessary to take measures to raise the blood-pressure before and during operation, it is wrong to think that the dose for spinal anæsthesia can be diminished.

Other pathological conditions tend to cause resistance to spinal anæsthesia and Professor Sebrechts has found that among patients in a critical state a normal dose gives a slow, light, and short anæsthesia, and he always increases the dose in such cases. Cases with tuberculous peritonitis and ascites are resistant. On the other hand, cases of intestinal obstruction and enlarged prostate are sensitive, due, he believes, to the depression of the bulbar centres by intestinal toxin and increased blood-urea.

He also draws attention to a marked familial character in the reaction to spinal anæsthesia and quotes illustrative cases in his own experience. In one case a man after a large dose correctly given showed no anæsthesia and could walk round the operating room. The operation had to be performed under chloroform anæsthesia.

His two sons at a later date were operated on and both proved to be equally resistant. Inquiries are now always made as to whether another member of the family has previously had a spinal anæsthetic administered.

Where spinal anæsthetics fail, Professor Sebrechts states that the patient is difficult to anæsthetize by inhalation, and that then chloroform is the only drug to be employed.

It is stated that later pulmonary complications do not occur as a result of spinal anæsthesia. This is not in accordance with our own experience in which we find a fair number developed cough and expectoration. By giving a small dose of gas and oxygen and finishing up with some carbon dioxide, this tendency to bronchial trouble has been diminished in our practice.

In contradistinction to the experience of Professor Sebrechts, Professor Quarella states he has never met a case which appeared to be resistant to spinal anæsthesia.

Undoubtedly the use of percaine in dilute solution is a distinct advance in the methods of procuring anæsthesia for surgical procedures, especially for abdominal operations where good relaxation and a quiet condition of the intestines is required.

Of the different techniques described we are satisfied that the methods of administration adopted in this country which follow in all important details the technique advocated by Dr. Howard Jones give generally the most satisfactory results. If a case described as resistant to spinal anæsthesia is met with we would prefer to have resource to a general inhalation anæsthetic rather than introduce large quantities of percaine solution into the subarachnoid space.

Further study and observation of the cause of post-operative headache and the best methods of relieving it are desirable.

Some workers have observed marked and permanent relief from the intravenous injection of twenty cubic centimetres of fifty per cent glucose solution. Rectal injections of magnesium sulphate are also useful.

It is hoped that the method may have a more extended trial amongst Army surgeons and that their results will be recorded.

In military practice, where urgent cases may occur in isolated stations abroad and at sea, a surgeon may be able to perform necessary life-saving operations which might otherwise be impossible.

The much diminished fall in blood-pressure which follows its use when compared with other drugs and methods of spinal anæsthesia promises to make it a useful addition to our methods of dealing with seriously wounded men in war, and for this reason alone demands that a thorough trial should be carried out by Army surgeons in times of peace.

Clinical and other Notes.

THE CREOSOTE TREATMENT OF LOBAR PNEUMONIA.

By Major R. McKINLAY,
Royal Army Medical Corps.

During the year 1932, twenty-two cases of lobar pneumonia were admitted to the Indian Wing of the British Military Hospital, Belgaum, Deccan, Southern India.

	Cases	Deaths
Regulars	9	Nil
Territorials	1	Nil
Reservists	11	2
Followers	1	1
	22	3

With one exception, all cases were treated with creosote enemata according to Schoull and Weiller's method, as described by Dr. Ian McDonald in a letter to the *British Medical Journal* of December 12, 1931, p. 1111.

Considering the types of the subjects (mostly recruits) and their presumed high degree of susceptibility (most of them rural dwellers), the results were most gratifying.

As a rule, under the creosote method temperatures are lower than is usual in this disease, crisis is hastened and frequently the temperature falls by rapid lysis. Also—most striking feature of all—toxæmia is lessened. In fact, in this group of cases the observation made in the letter to the *British Medical Journal* was confirmed, viz.: "The action of creosote in the purely pneumococcic conditions seems to be almost specific, like serum; when it fails, a streptococcic infection must be feared."

Of the fatal cases: (*a*) One, a very toxic case, was not treated with creosote. It was considered unfair to expose him to the grave risks attendant on a trial method of this kind.

(*b*) Another was dangerously ill on admission: from the very outset delirious and extremely toxic. The Command laboratory reported: "A case of virulent pneumococcal pneumonia."

(*c*) The third was a sweeper, not living in his unit's lines, who had been absent from duty for three days and who was brought by his friends to draw his pay on August 1. He was then ill, and was admitted dangerously ill on August 2. Unfortunately, I was on leave at the time so did not see him. Creosote treatment was begun on August 4. It was too late: death took place two days after.

To date (January 28, 1933) four more cases of lobar pneumonia have

been admitted, of which two were very ill indeed. Under creosote, three have done well. The fourth is still dangerously ill with high fever, delirium and toxæmia—one of the worst cases I have seen. However, I am sure that were it not for the creosote treatment this man would now be dead. I hope to pull him through.

Territorial training is now in progress, and Reservist training begins in March. Should the results of creosote treatment continue to be as favourable as heretofore, a further communication on the subject will be made.

Meanwhile, I can heartily recommend this simple and inexpensive procedure to those who have to tackle the king of destroyers.

NOTE ON A NON-MANNITE-FERMENTING ORGANISM RECOVERED FROM TWO CASES OF DYSENTERY.

By Captain G. T. L. ARCHER,
Royal Army Medical Corps.

The organism which is the subject of this note was isolated from two cases of dysentery which occurred in Wellington, India, in 1930. As it resembles, yet differs from, both *B. dysenteriæ* Shiga and *B. dysenteriæ* Schmitz, it is thought that a brief description of its characters may prove of interest, and possibly of value to others who are working at this subject.

Both cases presented the usual clinical features of bacillary dysentery.

Microscopically the exudate was of the "indefinite" type. The organism was in both cases isolated early in the disease. In the second of the cases an amœba was seen on one occasion, but as this did not contain erythrocytes, and as subsequent examinations were negative, it was not considered to be *E. histolytica.*

As the organisms from the two cases were identical in their biochemical and serological characters, they will be named in this note by the laboratory index number of the first, viz., J.L.

Morphological and Biochemical Characters.

Nature of organism	Size	Gram's stain	Lactose	Glucose	Mannite	Dulcite	Indol
Non-motile bacillus	2 to 4 μ by 0·4 to 0·6 μ	Neg.	No change	Acid	No change	Acid after four days	Neg.

J.L. therefore differs from *B. dysenteriæ* Shiga in that it ferments dulcite, and from *B. dysenteriæ* Schmitz, in that it ferments dulcite and fails to produce indol in peptone water.

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Serological Reactions.

The serum of the patients gave the following results :—

	Homologous organism	*B. dysenteriæ* Schmitz	Other organisms of dysentery group
Serum of first patient	Not tested	1/50	0
Serum of second patient	0	1/250	0

Homologous serum and diagnostic high titre sera acted as follows :—

	J.L.	*B. dysenteriæ* Shiga	*B. dysenteriæ* Schmitz
Homologous serum (J.L.)	1/1000	0	1/25
Anti-Shiga serum	0	1/500	—
Anti-Schmitz serum..	0	—	1/500
Anti-Schmitz serum absorbed with J.L. ..	0	—	1/500

Apart from the rather surprising fact that the serum of both patients contained agglutinins for *B. dysenteriæ* Schmitz, there appears to be no serological relationship between J.L. and Shiga or Schmitz.

Animal Inoculation.

A rabbit inoculated with a living emulsion of J.L. in saline died after five days. No ulcerative lesion was found in the intestine and the organism was not recovered from the heart or liver.

One of two rabbits injected with a killed emulsion of J.L. died two days after inoculation.

A rabbit fed with J.L. showed no symptoms of any kind.

A filtrate of a broth-culture of J.L. (N.B., this experiment was made recently, and the organism had passed into the "rough" phase) produced well-marked toxic symptoms in a rabbit when injected intravenously. A second rabbit inoculated with filtrate plus specific anti-serum was affected to a much less degree. A third which received plain broth showed no symptoms at all.

Conclusion.

So far as I am aware an organism having these characters has not previously been described. Although the above experiments in no way prove its pathogenicity to man, it seems possible from its resemblance to other well-known types that this organism may have some connection with the dysenteric condition from which the patients suffered.

P.S.—Since writing this note attention has been drawn to the biochemical resemblance which this organism bears to the "Newcastle" bacillus described by Clayton and Warren (*Journal of Hygiene*, vol. xxviii. p. 355). On no occasion, however, did J.L. produce gas in either glucose or dulcite.

NOTES ON DRINKING WATER COOLERS.

By Major R. A. Anderson,
Royal Army Medical Corps.

Some very good innovations in designs for the provision of cool drinking water are in existence in the China Command. A few details are given in the hope that they may be of use to others serving in the Tropics.

In the United Services Recreation Club at Hong Kong, and in some of the Golf Club houses, water coolers (I think the maker is "Cordley") are in use. The cooling part consists of a white enamelled outer container, inside which is a white glazed porcelain flask with a small neck into which the neck of the upper glass water container fits; a rubber collar prevents breakage. The top of the porcelain flask is flush with the lid of the cooler. Ice is placed around this porcelain flask between the outer container and the flask. These coolers are expensive: they cost about £6.

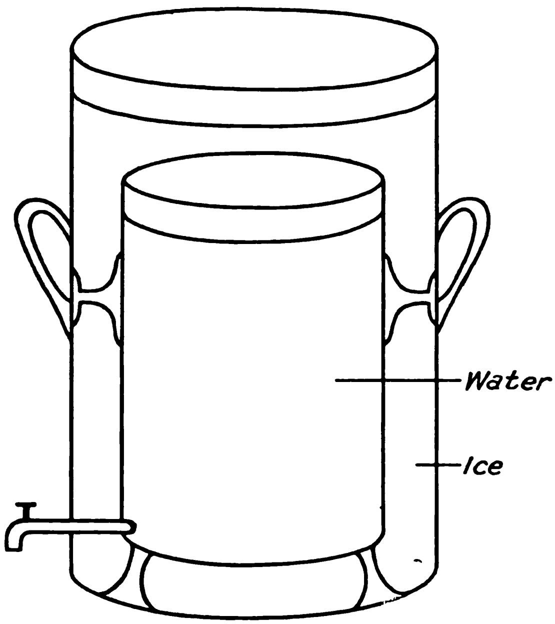

Fig. 1.—Dimensions: Inner Tank, Diameter 16 inches; Height 18 inches.
Outer Tank, Diameter 20 inches; Height 21 inches.
Cost: £1 2s. 6d.

A similar type of cooler has been supplied for the men, out of regimental funds, by the 1st Battalion Queen's Royal Regiment at Tientsin, in the proportion of, I think, one per Company. The only difference in the design I can remember is that the upper bottle is rounded.

A very efficient and cheap type of water cooler, called the "Griffin Cooler," has been designed by Major Griffin of the 1st Battalion The Lincolnshire Regiment. This cooler was used by the battalion while stationed at Shanghai during the hot weather.

I am indebted to him for allowing me to use his notes and diagrams. I quote verbatim from the notes :—

"The problem of providing an adequate supply of iced drinking water for troops in hot dry climates is more or less successfully solved by the use of "Chatties" which depend on a high rate of evaporation for their cooling properties. In climates such as Shanghai or Hong Kong, where the humidity often stands at ninety-five per cent with a temperature of ninety-eight degrees, there is practically no evaporation and consequently no cooling of the contents of a "Chattie," and other means have to be found to keep a supply of cold drinking water available. It has been found that a double zinc or galvanized iron tank constructed so that there is an air space between the inner tank (or water container) and the outer tank which can be packed with ice, meets the case. (See fig. No. 1.)

"In a battalion of 850 strong it was found that five such tanks located in dining halls (one per company) were sufficient to ensure an adequate supply of iced water in the hottest weather. Each tank was issued with forty pounds of ice twice a day at 7.30 a.m. and 4 p.m.—cost eighty cents per tank per day—and as water was drawn off, fresh water was poured in.

"On a parade being dismissed I have seen one hundred men file past a tank and each draw off a mug of water, the last mug being as cold as the first.

"Another method also found very effective and especially suited to icing draught beer is as follows :—'The beer or water is drawn off from the barrel or container and led through twenty feet of coiled glass tubing. The tubing is coiled in a tin lined double wooden box and is packed in ice.' This method is more economical in ice, requiring only about twenty pounds a day, but is more expensive to instal—costing about £1 10s."

With regard to these coolers the following remarks are made :—

(*a*) Water cannot be drawn off from the ice container as the ice melts.

(*b*) The amount of ice used could, I think, be considerably reduced if the water container was constructed with a cavity in which some non-conducting material was put.

(*c*) The designs could be improved by having feet so as to raise the apparatus, allowing air to circulate underneath, which would be less of a heat conducter than the surface on which it rests without feet.

The following improvements could be made in the Griffin cooler design without, I think, much extra cost. When the outer tank is being constructed, it could be made double so that granulated cork, sawdust, asbestos, or other non-conducting material, thoroughly dry, could be filled in between the two containers, and soldered off, with the lid similarly constructed. The outer container should have feet and a small tap to drain the ice compartment.

A small pulley float could be included to show the water level; if so desired the apparatus could be so arranged under a tap, with a ball valve

connection similar to that on any water tank, as to make the apparatus fool-proof and avoid handling. The outer lid should be constructed in two halves, so that ice could be added through one half. (See fig. No. 2.)

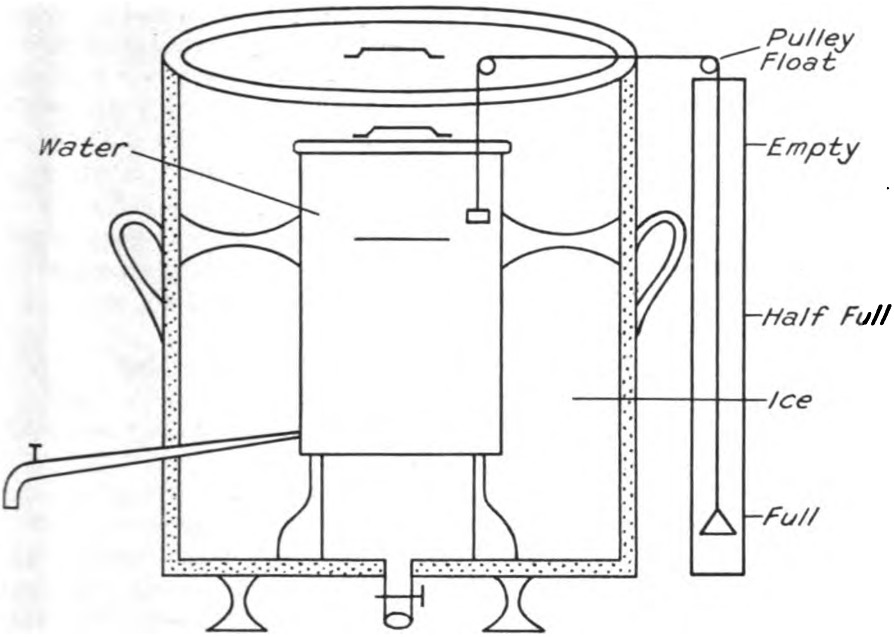

Fig. 2.

With regard to the other type of cooler used by Major Griffin for cooling draught beer, a modification could be adopted. The box might be made of non-conducting material, so as to conserve the ice, and should be drained. The coil might be of some cheaper tubing than glass.

A type of water cooler could be made with the ice container in the centre of the water. This type of water cooler would probably prove more economical in the use of ice. It would probably also prove more economical even without the sides of the outer container being non-conducting.

I am indebted to Colonel C. D. Myles, O.B.E., A.D.M.S., China Command, for his help and suggestions, and for permission to forward this article for publication.

ACHLORHYDRIC (MICROCYTIC) ANÆMIA IN A MALE.

By Captain F. J. O'MEARA,
Royal Army Medical Corps.

The clinical notes of this case are submitted for publication as, though the disease has been described in the female, its occurrence in the male sex is not generally recognized.

In January, 1933, a recruit in the Royal Corps of Signals, with nine

weeks' service, was admitted to the Military Hospital, Catterick, suffering from influenza. He was a Cornishman, but he had not been in a tin mine. On physical examination he was found to be anæmic: his skin was a greenish-yellow colour, his mucous membranes were pale, and his scleræ were clear. Examination of his eyes did not reveal any clinical abnormality. The optic discs and fundi oculi were normal. His teeth were in good condition. His heart was not enlarged. On auscultation a bruit, systolic in time, was heard loudest over the pulmonary area. In the abdomen the spleen was enlarged one inch below the left costal margin. It was easily palpated and was of firm consistency. His nervous system did not show any abnormality, and the abdominal reflexes and knee-jerks gave normal responses. When he had recovered from the attack of influenza, which was complicated by pneumonic consolidation at the base of the right lung, his condition was further investigated.

There was no fever and his pulse varied from 60 to 74 beats per minute during the remainder of his time in hospital.

The urine was acid; specific gravity 1028; albumin nil; sugar nil. There was a deposit of amorphous urates.

The fæces gave a negative reaction to the benzidine test for occult blood on three occasions. No ova of *Ancylostoma duodenale* were seen.

The total red cell count was 4,850,000 per cubic millimetre. The average diameter of the red cells was 6·5 μ; no nucleated red cells were seen.

The total white cell count was 16,600 per cubic millimetre.

A differential white cell count showed polymorphonuclears, 61 per cent; lymphocytes, 32 per cent; large mononuclears, 4 per cent; eosinophils, 3 per cent.

A fractional test meal showed the volume of resting juice to be eighteen cubic centimetres. There was bile regurgitation at two hours. The stomach was empty at two and three-quarter hours. There was no free hydrochloric acid in any specimen (histamine hydrochloride was not injected). Total acidity was not above twenty per cent in any specimen on titration against $\frac{N}{10}$ NaOH.

During the period he remained in hospital, awaiting his discharge from the Army, he was given two drachms of dilute hydrochloric acid in ten ounces of water, three times a day with his meals. After meals he received ferri. et ammon. cit. in thirty grain doses three times a day.

My thanks are due to Major W. A. Frost, O.B.E., R.A.M.C., for the details of laboratory investigation and to Lieutenant-Colonel R. P. Lewis, D.S.O., R.A.M.C., Officer Commanding, Military Hospital, Catterick Camp, for permission to forward these notes for publication.

Travel.

BEYOND LEH.

A SHOOTING TRIP IN LADAKH, 1926.

Being a Diary kept by

K. W. DICKSON, F.R.G.S.

(*Continued from p. 461, vol. lx.*)

VII.—Beyond the Snow.

Coming into the Kargil valley was like a bound from winter to spring; the fruit trees were in blossom and the willows a soft green; the nibbled turf was like velvet, and so refreshing to the eye after the glare of the snow.

Kargil is really a collection of villages where many valleys converge. The bungalow is high up beyond the bazaar, and commands a fine view of the valley opposite, and a great circle of hills.

We had a perfect day to rest there; a cloudless sky. The servants very soon had the bedding in the sun, and clothes were washed.

We had found our English mail waiting for us the day before, but a later one arrived that day, so we hurried down to the bazaar to get our shopping done before settling down to answer our letters. The chowkidar was given orders to have the chimney swept during our absence, as we had been smoked out the day before.

As we were right away from the snow now, our chapplies were looked out and we wore them that afternoon to get a little accustomed to them again. Wandering up the hill with our purchases—matches, candles, and Sunlight soap—we saw a lama from Leh. I had not realized we would be in Buddhist country the next day.

R. took out the gun, and we walked down to the river and round the old fort looking for pigeon, but saw none.

As I sat down with my notebook at Moulbeck, R. was busy emptying jam from the tin into our jam-pot; doing all the household duties, he said, while I wrote the diary.

Jit Ram had wakened us at 4 instead of 5 o'clock, so we had an early start. The pony men were like a lot of little Chinamen; quite a different type from the men of Dras. Our path lay on a little esplanade by the river for the first mile, then crossed the river by a suspension bridge. The tiffin coolies took R. and the dogs up a steep rocky path, but the pony man refused to go that way, so I was taken by a different route, expecting to see them a few hundred yards ahead; we went up and up and round corner after corner until I really wondered if one of us had missed the road. We emerged on a large plateau, very stony but quite level; even here, when I could see a mile ahead, there was no sign of R. or the dogs. The Ladakhi and his nice little black pony didn't look as if they meant to kidnap me.

At last I saw heads appearing over the hill, and the barrel of a gun glinting in the sunlight, and I recognized them at once. I found that R. had been as irritated as I was at being taken along this road; he had taken the coolies at a great pace up the steep path, then took long breaths and spoke to Subhana, who had no breath to answer.

A disused irrigation channel runs across the plateau, made more than thirty years ago, I was told, only to find that the supply of water was inadequate for any practical purposes.

It was very cold and windy, but we got a fine view. Our path lay right across the plateau, then wound downhill to Pashkyum, a pretty village by the river, its fields shaded by poplars and willow trees. There is an old fort on the hill ahead, its watch towers dominating the valley in both

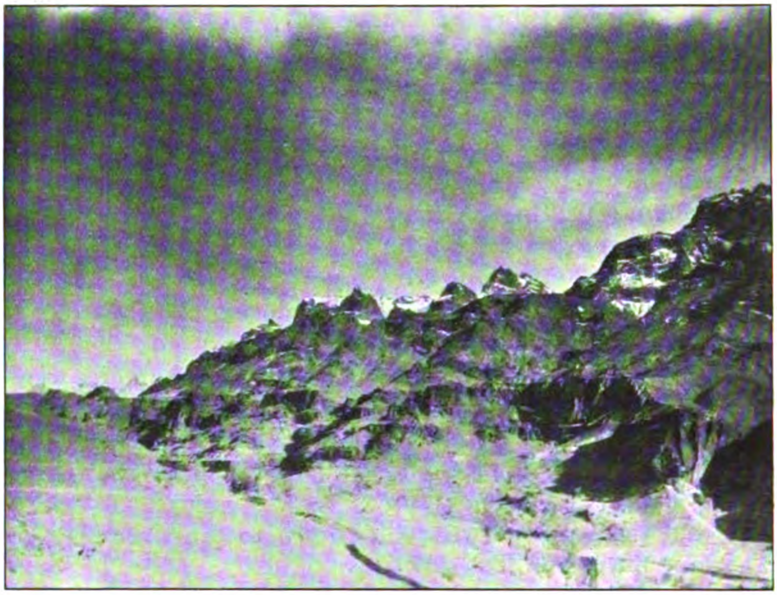

FIG. 4.—Typical cliffs and hills near Moulbeck.

directions. We followed the right bank of the river up steep slopes and over precipices. We saw Topi, a village which has an extraordinary situation on flat ground far above the road; so far as we could see, there was nothing but a goat path leading to it, up the face of the cliff.

We soon came to Lotson, a pretty village built amongst sandstone rocks. After crossing a stream we looked for a suitable place to have tiffin, as we were both very tired and, for once, not too hungry. Our cocoa, cheese, and country meal scones did not taste good that day.

Leaving the village behind, we started off again through the same rocky, stony, barren country. We wound round hill after hill, on and on, past shale-covered hillsides, a few crows about, but not even a weed growing anywhere. We took turns in riding the pony; R. took quarter of an hour

to my half hour, and so the time passed until we saw a little monastery built into the cliffs above Shergol. There we decided to make tea by the river. We sat down among a few willow trees and behind a rock, as there was a very strong wind, and I dropped off to sleep while the coolies made a fire and boiled the kettle. We had come nineteen miles already, so rested for an hour, feeling that we were not far from our destination. Our transport passed us while we were at tea. Even after the rest the road seemed to wind on interminably. I think it seemed more monotonous than usual, as we had no sunshine that day to put colour into the rocks and brighten up the hillsides.

The ancient monastery of Moulbeck was visible from a long way off,

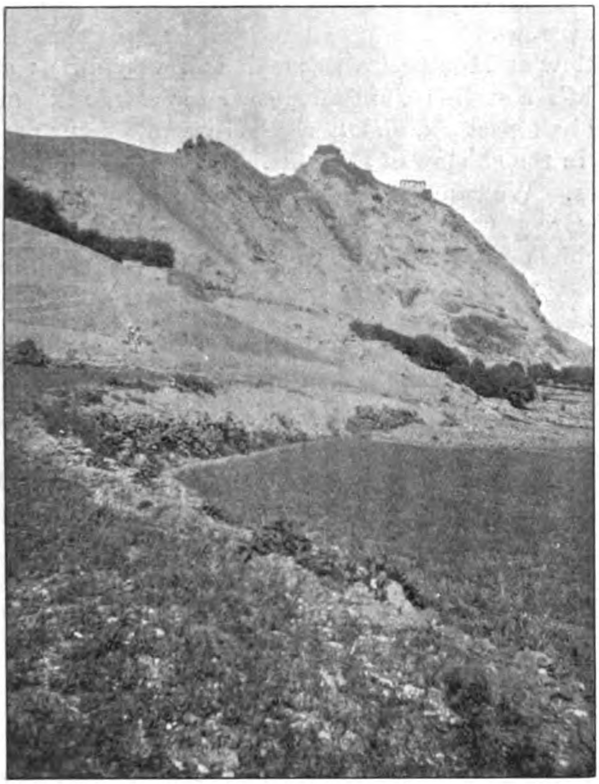

FIG. 5.—Monastery on hilltop, Moulbeck. Taken on our return journey

built on a pinnacle of rock; two buildings intact, but the top of the rock was covered with crumbling ruins. Here we saw chortens for the first time; a monument usually shaped like an urn on a pedestal; they are supposed to contain the ashes of some saint. The people were quite different from any we had seen before; a Chinese type of face, and they all looked so healthy and had really rosy cheeks. Both men and women wear skin-lined caps, usually blue, and lined with black goatskin; these

fold down rather like a Balaklava helmet, and fasten beneath the chin when it is cold. They all wear a long woollen coat of natural-coloured wool, the same colour as the rocks, the hills, the stones, and the road. This cloth is woven by the women in the villages in strips only eleven or twelve inches wide, so a Ladakhi's coat has many seams in it. The men wind a dark coloured sash round the waist; it has a long fringe at the end, and in the sash some have knives, and all have flints and steel in brass cases, and a brass or copper spoon. Black silk threads are plaited into their pigtails to make them the proper length; all the men have long thin pigtails, and I saw a little leather tab far down the back of a coat, with the pigtail stuck through.

The people are all engaged in agriculture, and look a happy, contented lot. They show rows of shining teeth when they greet us.

The bungalow at Moulbeck was small and very dirty; still, we had a very good night's rest there, and made a later start next morning. The sun was up by half past six, and it seemed warm as our path was in sunshine, and not in the shadow of the hills. There seemed to be monasteries every few miles. We came to another small one not far from Moulbeck, with a huge figure of Chamba carved on the face of the rock. Further on, the road branched off to the left quite unexpectedly to me, instead of going up the main valley by the water. Our path was on open ground and easy going, but oh! in such a desert; not a blade of grass, not a tree anywhere; not an animal or an insect, and not a drop of water! No one was inclined to talk. I thought of the children of Israel in the wilderness, and didn't wonder that they rebelled, if the desert was like that; they would certainly need manna from Heaven in such a place.

At the end of the valley we came to one well-built hut, but it, too, seemed deserted. My pony man whistled cheerily—quite a contrast to the singing of Indians or Kashmiris.

We knew there was a pass ahead of us that day, the Namika La; a cheery thought, as it would certainly mean more than a glimpse of new country. Sure enough, we began to climb as soon as we got out of this valley. We saw some chikor, but had no luck with the gun. R. had done a lot of extra climbing after chikor, so I gave him the pony for the last steep part of the pass. I put Garry on the lead and kept behind R., and Garry pulled well. We had a rest at the top of the pass, and got a very extensive view, so got out the compass and map, and with the aid of the protractor, we spotted two snowy peaks, one 19,000 and the other 20,000 feet high; the latter beyond Leh. The pony man sat and played his tin whistle, while we lay and looked at the hills. Then we started off downhill with a swing; down, down, by dried-up river beds and drier hills still; not a sign of life for miles. We had a quarter of an hour's rest under a shale bluff in the sun, and I went sound asleep.

About a mile further on we stopped for lunch in what we thought was a sheltered little gully, but we did not know the climate of Ladakh. In

half an hour it was bitterly cold, a strong wind blowing, clouds over all the sky, and heavy snow falling on the higher hills. We packed up our lunch basket and hurried on, thinking we had but three miles to go. It was cloudy, windy, and very dusty. We saw more chikor, but they were too far away.

There were many tiny hamlets on both sides of the river, but no Kharbu with its Dak Bungalow. One monastery was most picturesque, perched on a rock above the river, its white-washed walls and red-painted eaves the only colour in the sombre landscape. The first Mani wall that I noticed

Fig. 6.—Village on the cliff and the first Mani wall.

was just before Kharbu. I imagined then that it was a sort of cemetery with little tombstones on the top. It was not until I got to Leh that I heard that these were sacred walls; devout Buddhists pay a monastery for an engraved stone, on which are the well-known words, "Om Mani Padmi Hum," a phrase which has more than one meaning but is usually translated "Oh, the God of the Jewel in the Lotus Flower." The donor acquires merit by placing this stone on the wall in the same way as by building a chorten, but no merit is acquired by mending a broken-down wall or chorten, so the ruins of these emblems of Buddhism are scattered everywhere throughout Lama-ridden Ladakh.

VIII.—Kharbu to Saspul.

Kharbu lies at the foot of cliffs which are covered by the most wonderful old ruins of castles and huts—looking for all the world as if they had come out of a fairy tale or some legend of long ago—a castle in Cornwall in the

days of King Arthur, or a picture by Arthur Rackham. We had often thought that Dagshai from Kasauli, on an August evening, would give Arthur Rackham new ideas, but that was the wonderful light in the monsoon; here, with no aids in the way of lighting, were real castles on spiked peaks of rock. We spent a little time looking for possible ways of climbing up, which certainly were not obvious. We found the bungalow on the far side of the village, and sat for a long time on the verandah, very tired and weary. Clouds were still coming up and it did not look too well for the morrow. R. went out and shot some pigeon while I gave out stores. There was a hole a yard across in the roof of the room in which we were to sleep; it didn't help the chimney to draw well, but the caretaker put the table from the other room on the top of the hole, and we were very comfortable.

A field was being ploughed not far away, about a dozen people working in half an acre of ground; a man directing the plough, another sowing seed, while others made the ground smooth again. They were using yaks for ploughing, or rather the tzo, a cross between the yak and the bullock. They all sang quite cheerily a rather mournful song. Our shikari's son said the words were, "When death comes to me, may I not die." Whether this wish included the usual hope of being re-incarnated a rich man's son, I do not know.

While I was watching the ploughing a young girl came to fill her brass water jug at the irrigation channel; she was the first woman I had seen wearing the pherak, the Ladakhi head-dress. It is made of paper pasted together, then covered with red cotton cloth; it is shaped like a cobra, the tail hanging down behind; turquoises are sewn on to the red cotton which covers the pherak. A woman's wealth is carried on her head; even a poor woman has usually a pherak worth 30 rupees, but many carry 300 rupees' (roughly, £20) worth of turquoises and corals. The hair is plaited with goat's hair into a lappet worn one on each side of the head; these represent the hood of the cobra. Christian women discard this head-dress, as it is of Buddhist origin. Quite a crowd of girls stood watching us before they went off with their water jugs. Their dark claret-coloured woollen frocks reach down to the ankles; the children wear long dresses too, with little caps lined with goatskin. The people have very fresh complexions, although they are so dark. I was thinking how nice and pleasant they looked when one rather took my breath away by expectorating with great precision just beside me.

The ground was white with snow when we woke next morning, the first of May.

There was not much to relate of sights on the road that day; there were more ruins of old castles on spiked peaks, and we got a nice photograph of some with snow in the foreground. We found the pull up to the Photu Pass a very long one, although the guide book says it is easy. We stopped for lunch in warm sunshine before we reached the top, but once

again we were had by the climate of the country. In ten minutes the sun had gone behind a cloud, and a piercing blast came up the valley; the coolies all crouched down behind bushes, and we got under a coat and hurriedly finished our meal.

After a short walk we were at the top, and a fine stretch of hills came into view, the Ladakh Range behind the Indus. I did love those marches when there was a pass to climb! We ran almost a mile and a half downhill, passing ponies and servants on the way. Then another weary walk on a dried-up river bed with high mud cliffs on one side; a short steep ascent, and Lamayuru came into sight from behind some chortens. On that dull afternoon it looked like a city of the dead, built on the top of honeycombed rocks or mud cliffs, with a bare monastery crowning the village. Set away amongst those hills, Lamayuru looked like some mediæval place of torture, or, as R. said, like a picture from Dante's Inferno. The rest house lies just under the village. An interested crowd of children, huddled together in their goatskins, sat and watched us as we had tea on the verandah. I gave the dogs the remains of the tea, and the children shrieked with laughter when Kelpie begged and held out paws. Unfortunately the dogs were too hungry to be funny or do any tricks, and Kelpie ended by making a dash for the kitchen.

Two Lamas passed with ponies laden with grain, and R. took a photograph of them.

Khansamah gave us a good dinner—mutton broth, roast fowl, and rum soufflé; and we were in bed by half past seven.

The march from Lamayuru to Nurla seemed longer than it really was, a distance of eighteen miles. We left at the usual time, but put off some time going after pigeon. We had seen hundreds the night before, so R. took the gun and tried to get as many as he could with one shot; they were badly needed for the pot, as the servants had nothing but chuppatties and salt, and we had not too many cartridges. He got three with one shot, then we moved on and saw more later, but too far away. The path then left the valley and wound down and down the beautiful gorge towards the Indus. It was very narrow in parts, and we got only one photograph as the light was not good, and our films were too precious to waste. There was no vegetation of any kind, but the colour in the hills was wonderful; sometimes looking ahead I thought we might have been on a Scotch moor; the hills a soft purple but with streaks of green sage slate; then we rounded a corner to see a ridge of soft mulberry-coloured hills, with sharp outcrops of russet sandstone like castles built on cliffs.

After crossing a fine bridge over the Indus, we came to Khalatse by 11 o'clock. It was a beautiful little village, with willow trees just green, apricot blossom and green fields. After a weary trudge in soft sand beside Mani walls, we passed a pretty orchard with a house in the centre, and I was surprised to see "Rev. Burroughs, Moravian Mission," above the doorway; a simple mud house, but the orchard was very tidy and well kept.

If only I had known there was a Mrs. Burroughs and children, I would have gone in to see them, but never dreaming that a woman would be settled in such a lonely spot, we went on without calling—an unforgivable sin!

We rested and had lunch on the edge of a tiny field, leaning against big stones which were part of the dam keeping a little irrigation channel behind us from flowing on to the fields. A lot of happy looking little girls watched us, peeping from behind the retaining walls of the fields below; all the cultivated ground is built up in terraces. They all had little wooden spades, but these were for real work, not for playing in the sand. They were not actually digging, but damming up some channels and opening others to let the water over all the fields. We saw the women in Bod Kharbu using English spades, and, funnily enough, I had seen at Kargil spades with a Sheffield label on them for sale in the bazaar. I have never seen an English spade in use in the Punjab. The Indian pattern is made like a hook instead of being flat, and is used more as one would use a pickaxe.

The road was not interesting after leaving Khalatse, but the colouring of the hills was wonderful, and formations of rock-like ruins of old castles stood out on the nearer ridges. I think the architecture of the monasteries must have been taken, either consciously or unconsciously, from these formations.

The path was rough and stony and covered with boulders; then it crossed deep sand, past long lines of Mani walls. The road always winds on both sides of these walls. There is a legend that blessing comes to those who pass keeping the wall on their right, so naturally a path is trodden on both sides, and good Buddhists may follow the tradition of their people going in either direction.

Nurla was another pretty cultivated spot, but the Dak Bungalow, although built on a high bank above the Indus, faces the wrong way, and the verandah looks into mud walls. We had come 18½ miles, and we were both very weary when we arrived there. It was Sunday, our day for writing home, but I didn't feel equal to beginning my letter, and even left the diary a day in arrears.

Our pony men would go no further than Nurla, although they had promised to go with us to Leh. We counted up our money and found we had not enough to pay them and leave sufficient for bungalows and other expenses to Leh. We were arranging with the shikari to send the money to the Thesildar at Kargil, when Jit Ram came in very excited with a story about shawls, syces (our own grooms), etc. He spoke so fast I could not understand, and made him speak slowly. I discovered he had brought all the money he had to help us, and did not want it back until we returned to Srinagar. The syces had given him money before he left Lahore to buy puttoo rugs, country-made tweed, for their wives. Jit Ram had been with us for only six months, yet he trusted us with all the money he had, as the

syces had trusted him with their money. One hears a lot about the new type of servant since the war, but here was one you could not help trusting when you looked at him. He got very muddled and never put anything twice in the same place in camp, but he never groused, and was so honest I felt I had some one with us whom I could trust all the time.

It was a cheery, happy march to Saspul, not such a long road. We kept beside the Indus, and even although the sun was not shining, the

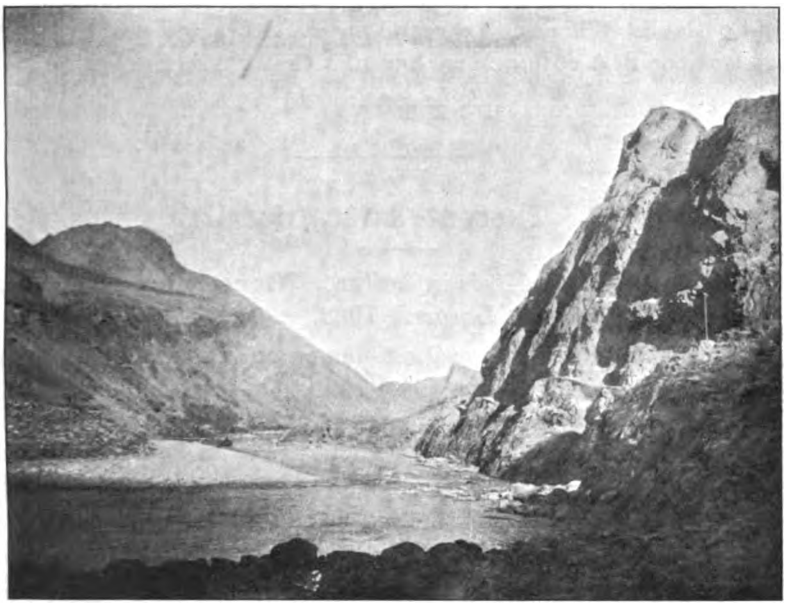

FIG. 7.—Path between Nurla and Saspul.

water was a lovely sage-green colour, and against the mulberry hills the contrast was good. The path had a very rough surface again, and going steadily we did not do more three miles an hour. R. shot one chikor before lunch, but we got no pigeon that day. Kelpie was very afraid when he saw the gun, while Garry never moved, he was so interested. Later Kelpie associated the sound of firing with some shikar, and then there was no holding him when a shot was fired.

We ate our midday meal right down on a little beach by the river, on soft grey sand; we had to lay a coat down to keep the sand out of our food.

I had a sturdy grey pony and a decent pony man; he had a fine pair of Tibetan boots made of woven hair with natural coloured woollen cloth tops, and a bright scarlet strip embroidered up the back. The rest of his dress was not quite in keeping with the boots; his pigtail, which reached to his knees, had soiled his coat so much that it looked as if it had been smeared with blacklead right down the back.

The rest-house at Saspul stands high above the village, with a grove of poplar and apricot trees in front; the servants' quarters were below and our rooms upstairs. From the verandah there was a fine view over the trees and near fields to the hills on the far side of the river. Heavy dark clouds were hanging about when we arrived, but it cleared up in the afternoon. We wondered what sort of weather they were having in Srinagar, and if it was snowing again in the Zoji La.

R. went off to bed early, but I sat and wrote the diary until after 8 o'clock, while the wind howled in the poplars outside like a November night in Scotland. There was a grand big wood fire and a stuffed armchair, and that was the first chimney we had met that didn't smoke.

(*To be continued.*)

Current Literature.

WULFF, F. Om mononucleosis infectiosa. **[Concerning Mononucleosis Infectiosa.]** *Ugeskr f. Laeger.* 1933, v. 95, 131-5.

Mononucleosis infectiosa was first demonstrated in Denmark in 1927. But it would seem to be quite prevalent to judge by the following observations. For twelve months, from August 1, 1931, Wulff examined the blood of all the 258 patients admitted to a fever hospital in Copenhagen as likely to be suffering from diphtheria. A blood-smear was made immediately on admission, but the staining and differential counting was deferred till the following day. The May-Grünwald method of staining was employed. In as many as twenty cases mononucleosis infectiosa was diagnosed. In none of these could diphtheria bacilli be found, although they were sought repeatedly. All the twenty patients recovered—an issue putting out of court the diagnosis of lymphatic leukæmia. The clinical picture was in many cases extraordinarily like that of diphtheria, even severe diphtheria. Thus, in some cases the false membrane covered and extended far beyond the tonsils. A blood-stained purulent discharge from the nose and fœtor also were suggestive of severe diphtheria. Several patients were given serum before the true nature of their disease was recognized : bu they were at least saved from the discomforts of subsequent injections.

With regard to the systematic combing out of these cases in the future from material admitted to hospital with the diagnosis or query of diphtheria, Wulff points out that though enlargement of the spleen and of the lymphatic glands in parts other than the neck is suggestive of mononucleosis infectiosa rather than of diphtheria, the only really reliable test on which to base a differential diagnosis is the blood-count. And he means in the future always to examine the blood before giving serum to a suspect case of diphtheria.

C. LILLINGSTON.

Reprinted from "Bulletin of Hygiene," Vol. 8, No. 5.

Tuberculosis in the Tropics.

C. Wilcocks gives, in his recent paper (The Problem of Tuberculosis in East Africa, *East African Medical Journal*, 1932, v. 9, 88-98), an excellent account of his investigations in Tanganyika Territory during the last two years. He notes the fact that the earlier African explorers reported an absence of tuberculosis in Central Africa and that Peiper, in 1910, declared that the disease was unknown in Tanganyika until introduced by the Goanese and Hindoos; a statement which does not indicate any very precise date though the Indian penetration of the interior is probably quite recent. Wilcocks points, however, to the difficulties which must have been encountered in exact diagnosis by these earlier explorers and claims that recent advances in this respect have placed the recognition of tuberculosis on an entirely different footing. While this may help to explain the marked increase of cases within the last few years, he adds, wisely, that "it should not be overlooked that the observers of long ago were no more lacking in clinical acumen than we who have so many more advantages." As to the widespread existence of tuberculosis amongst the Tanganyika natives at the present time there can be no doubt. The incidence rates for the Moshi District, worked out on the findings of Wilcocks and Wilson as well as on the Hospital and Dispensary records of Dr. G. A. Davies, were, for the year 1931, as follows:—

Uru, 7·8 per 1,000; Old Moshi, 10·4 per 1,000; Kilema, 7 per 1,000. For the town of Moshi itself, the incidence worked out at the figure of 51 per 1,000; but here there may have been an error through the inclusion of some who had entered the town to seek treatment and had given a local address for registration. The figure, high as it is, can, however, be paralleled by the findings in certain closed communities, such as the Police Detachment of 162 persons, with an incidence of 18 proved cases or 111 per 1,000; and a school for 152 boys with 12 cases or 78·9 per 1,000. These figures appear alarming when one recalls that the death-rate is about 1 per 1,000 for England and Wales; but it has to be admitted that we have no guide to the incidence in this country, since the notification records are quite unreliable. If an intensive examination were made in some of our industrial groups, as was done by Wilcocks in Moshi, the results might be surprising. In a recent investigation of old and retired coal miners in South Wales, Dr. Enid Williams found no less than 6 per cent. to have a positive sputum, a figure which exceeds the incidence for Moshi town and approaches the figure for the boys' school. Here, of course, there was the possibility of the operation of a special industrial risk and the figures are probably higher than might be found in a similar age-group in some less trying industry; but Dr. Williams' findings invite us to be cautious in assuming that the Tanganyika statistics indicate a much wider distribution of disease than in this country. Certain points, however, in Wilcocks' cases seem to differentiate them clearly from those in Europe and strongly suggest to the reviewer that the disease is either of compara-

tively recent introduction, or that the habits of the population have undergone such a change as to make the epidemiological environment a new one. Of the first 725 cases of definite pulmonary tuberculosis diagnosed by Wilcocks in Moshi, 227 presented no physical signs which could be detected, yet, in nearly all of them, the sputum contained tubercle bacilli. This almost entire absence of physical signs co-existing with a positive sputum is a remarkable phenomenon and marks out this African population from corresponding groups in this country where symptoms and signs are usually present by the time that the bacilli appear in the expectoration. This larval state of tuberculous infection recalls that which has been recently observed amongst the populatious residing in the Native Territories in South Africa. It may be assumed that these Tanganyika natives, if suddenly transferred to work in a gold mine, might easily escape detection at the physical examination and yet would soon break down into a severe generalized tuberculosis under the stress of work in a new and trying industry. Another interesting point of difference between the Tanganyika tuberculosis and that of European countries emerges in the observation that of 940 X-ray films of native chests, 205 only gave evidence of lesions confined to the upper or upper and middle lung zones, whereas 227 showed lesions confined to the lower or lower and middle zones. The remainder were either unaffected or had lesions in all zones or in the middle zone only. This relative absence of selective localization at the apices and the tendency to distribution of lesions anywhere throughout the lungs is reminiscent of the findings of Opie in childhood infections and suggests that these lung lesions result from the persistence of primary foci of lung infection into later life. In other words, it looks as if the well-known tendency for primary foci to heal by calcification or fibrosis, so constantly noted in this country, were absent or uncommon in these African natives. In the establishment of a diagnosis of the tuberculous nature of enlarged cervical glands, Wilcocks found that puncture of the gland with a wide bore needle fitted to a five-cubic centimetre syringe and aspiration of glandular material for bacteriological examination often gave positive results. He says that: "this method is of peculiar value and that in the native a greater proportion of positive results is found than in the European." Here again is evidence of a liability to larval lesions in which the tubercle bacilli remain numerous and capable of generalization. The valuable observations of Wilcocks throw much light on the problem of tuberculosis in Africans and suggest that, in Tanganyika Territory at least, it still retains many of the characteristics of the childhood tuberculosis of Europe and the United States. F. Toullec and Jolly (*Bull. Soc. Path. Exot.* 1932, v. 25, 679-80) compare their tuberculin tests carried out on 285 recruits from the Ivory Coast disembarking at Marseilles with the tuberculin findings of Mathis and Durieux on recruits from various colonies of French West Africa, published in April, 1930, in the *Bull. Soc. Méd de l'Ouest Africain.* Whereas Mathis and Durieux found 46 positives in their

investigations, Toullec and Jolly find 34 per cent positives in the Ivory Coast recruits. While these figures might be taken to suggest a rapid progression of tuberculosis in the recruiting areas if compared with the 8 per cent reported by Sorel and by Arlo during Calmette's inquiry of 1912, the authors point out that no true comparison can be made unless the tests are applied widely over all age-groups in the actual bush villages themselves. Figures based on young male adults selected by physical examination cannot be regarded as conclusive of the whole territory. M. Fournials (*Bull. Soc. Path. Exot.* 1932, v. 25, 657-8; 658-62) contributes two short papers on the tuberculosis seen at the Chief Hospital of Dakar in 1930 and 1931. A large proportion of the cases were in European and African sailors of the merchant service or in Senegalese sailors transported to Dakar by sea. There were other cases of European origin which had either been recognized as tuberculous or whose true condition might have been detected by a more thorough medical examination. The author advocates a serious consideration of the question by the maritime medical authorities as well as the military health services. L. Lambert (*ibid.* 662-3) reports on the cases of tuberculosis admitted to the Native Hospital at Dakar during 1931. These cases were 96 in number out of a total of 2,504 admissions for all causes or 3·97 per cent. They produced, however, 12·8 per cent of the total deaths and gave a case mortality of 60·42 per cent. It is clear, therefore, that they were of severe type; and the author thinks that many of those discharged at the instance of their relatives or through inadequate accommodation, die within a few hours or days of leaving the hospital. He states, too, that, in his opinion, many patients dying of acute diseases such as pneumonia are in reality cases of more or less chronic tuberculosis in which an acute secondary infection masks the underlying condition. Mesdames Debeuf and Moyne reporting to the same séance of the West African Medical Society (*ibid.* 663-4) give a brief résumé of the out-patient tuberculosis at Dakar from which it appears that the disease is widespread in all the native quarters of that town and of Medina, constituting, in some places, family centres of infection. In the crowded centres of Dakar and Medina Abattoirs, the incidence and mortality are high and are augmented by the fact that many come from other areas already ill and seeking treatment for the disease.

Toullec (La tuberculose des Sénégalais. *Ann. de Méd. et de Pharm. Colon.* 1931, v. 29, 635-52) gives an excellent account of the present position of the tuberculosis problem in Senegalese soldiers serving in France. His paper forms a valuable supplement to the classical report of Borrel and Kerandel of their observations on African troops brought to Europe during the War. He describes the glandular stage with its characteristic features, wasting, loss of skin-gloss, depigmentation of the chest, muscular flaccidity, passing on to or accompanied by myo-œdema, and the development of Borrel's subclavicular gland; this last not an invariable occurrence but, when present, denoting the grave tuberculo-

caseous adenitis found so often in the tracheo-bronchial and mediastinal glands. The author is not in agreement with Armand-Delille as to the difficulty or impossibitity of diagnosing this intrathoracic adenitis by such findings as d'Espine's sign, Oelsnitz's sign and Smith's sign. On the contrary, he finds in those Africans with vast enlargement and caseation of the glands around and behind the trachea and between the main bronchi below the bifurcation, that the presence of this solid material occupying the posterior mediastinum conveys sound so readily that the stethoscopic signs along the dorsal spines are clearly audible and characteristic. He notes that the miliary type of hæmatogenous spread and the caseous pneumonia, while often seen and quite characteristic, are not so common as generally supposed. An interesting point on which he lays much stress is the frequency of polyseritic phenomena; pleural effusion followed by pericardial and often peritoneal effusions as well. This polyserositis of the Hutinel type he regards as especially characteristic of the tuberculosis of Africans when the latter are brought for the first time into contact with infection. He discusses the epidemiological side of the question and as to whether tuberculosis is or is not actually spreading in the French African Colonies. On the whole, he considers that the disease is spreading and that it may yet become a formidable problem, but he finds that there is some tendency to exaggerate the diffusion of infection at the present time. One of the factors which operates against extensive spread is the rapidly fatal course of tuberculosis in the African native. It is owing to this speedy disposal of potential sources of infectivity that the diffusion of the disease through the repatriation of ex-soldiers is minimal. The fact is that very few survive to become sources of danger in their villages. The risk from civilian natives returning after a period of exposure to risk in the large coastal towns is much greater and the evidence of tuberculin tests indicates that a gradual spread is taking place. The fact remains, however, that medical men practising in the interior still regard the disease as extremely rare. As one reads this article, shortly after the perusal of that of Wilcocks already referred to, one cannot fail to ask oneself whether it may not be possible that the infection may be spreading more extensively than is generally realized in these French African possessions. If, as seems to be the case in Tanganyika, the native is capable, under his normal home conditions, of contracting a type of tuberculosis so larval and insidious that it is unaccompanied by physical signs, it is at least possible that many cases may escape detection. Toullec discusses on general lines the question of prophylaxis and makes an interesting reference to the success which is attending the use of B.C.G. vaccine in the diminution of infantile and childhood tuberculosis mortality in and around Dakar, where the death-rate of vaccinated children has been halved since the start of B.C.G. immunization. He adds that the difficulties incident to the keeping and distribution of a living vaccine to places remote from organized and efficient laboratories have now been overcome by the introduction of a system of packing the sealed

phials in Thermos flasks filled with a glycerinated fluid and kept at ice temperature.

This method, if found satisfactory, should render possible an extensive trial of B.C.G. in Africa. The vast extension of B.C.G. vaccination in Indo-China is described by Gaide and Bodet (*Ann. de Méd. et de Pharm. Colon.* 1932, v. 30, 461-78) as a part of a paper dealing with Maternity and Tuberculosis in that country. A total of 161,707 infants have been thus vaccinated up to January, 1931, and the authors are more than satisfied with the results. The rapidly fatal miliary tuberculosis so common in infants and children in Indo-China is alleged to be much reduced in the vaccinated groups. From the text, however, the impression is gained that there is much difficulty in following up the cases. Still the authors are optimistic. "*Il est en tous cas permis d'affirmer que pendant les deux semaines qui suivent son ingestion aucun accident qui ait pu lui être attribué n'a jamais été observé.*"

S. L. CUMMINS.

Reprinted from "Bulletin of Hygiene," Vol. 8, *No.* 5.

Reviews.

WORKMEN'S COMPENSATION: ITS MEDICAL ASPECT. By Sir John Collie, C.M.G., D.L., J.P. London: Edward Arnold and Co. 1933. Pp. vii + 160. Price 7s. 6d.

To achieve a comprehensive and lucid exposition of the medical aspect of workmen's compensation in a book of 160 pages is no mean feat; to succeed in making such a book eminently readable and interesting we regard as little short of a triumph. Sir John Collie hopes that this book "will enable medical practitioners to acquire a working knowledge of the legal rights of those who have sustained injury at work."

It is very unlikely that the framers of the first Act in 1897 had any idea of how far the doors of compensation would eventually be opened. Did they visualize a workman drawing compensation for an injury continuing to do so after he had been sent to prison for a crime, or after he had been admitted to a mental institution for insanity? Could they imagine that a workman would receive compensation for an injury caused by his own serious and wilful misconduct, if such injury should result in death or serious and permanent disablement? Compensation now forms a large part of the working expenses of industry, and it is an arresting thought that in 1930 the amount paid in compensation to miners was £3 4s. 3d. per miner employed, or a charge of $2\frac{5}{8}$d. on each ton of coal raised.

In none of the Workmen's Compensation Acts is the term "by accident" defined. Until 1903 it was accepted that accident meant something

fortuitous or unexpected. It is now accepted that the expression "accident" is used popularly as denoting "an unlooked-for mishap or an untoward event which is not expected or designed by the workman himself." A case is cited where compensation was granted on account of death due to personal injury by accident, where a workman collapsed and died while tightening a nut with a spanner, and was found to be suffering from a large aneurysm of the aorta.

There are two chapters on medical examination with advice on how to write reports. The legal position of the medical examiner as regards the conduct of his examination is clearly described, with special reference to the detection of functional disturbances, and to methods of dealing with malingerers and cases of fraud. There are valuable chapters on industrial diseases, on treatment after joint injury, and on the relation of rheumatism and fibrositis to accident. The duties of medical referees are fully described, and there is an excellent chapter on the law of libel and the giving of evidence, in which is outlined the medical man's position with regard to privilege for his reports and statements.

An appendix contains the exact wording of Sections of the Act relevant to its medical aspect, there is a full list of the numerous cases cited in the text, and an adequate index.

We commend the book to all practitioners of medicine.

J. M. M.

EPIDEMIOLOGY IN RELATION TO AIR TRAVEL. By Arthur Massey, M.D., D.P.H. London: H. K. Lewis and Co., Ltd. 1933. Pp. viii + 60. Five maps. Price 7s. 6d. net.

This brochure will supply a much-needed want until such time as agreed international sanitary rules and regulations for air-craft travel are generally available.

It contains all the essentials; its recommendations are eminently practicable and are lucidly and simply expressed.

The maps, illustrative of endemic areas of the more important diseases and of air routes, developed and potential, are most helpful.

The book will prove useful to anyone concerned with the development of air travel and the sanitary problems arising therefrom.

P. H. H.

A FIGHTING HERBALIST: THOMAS JOHNSON, BOTANIST AND ROYALIST. By H. Wallace Kew and H. E. Powell. London: Longmans, Green and Co., Ltd. 1932. Pp. 151 and 23 illustrations. Price 8s. 6d.

In this book we have a worthy biography of the great herbalist and gallant soldier, Thomas Johnson, who edited the famous second edition of "Gerarde's Herbal," and lost his life fighting bravely in that glorious epic of the Civil War the defence of Basing House. With great care and skill Mr. Wallace Kew, who is president of the Lincolnshire Naturalists Union, and Mr. H. E. Powell, the librarian of the Royal Society of Medicine, have

here collected from the records all the available information concerning this excellent and distinguished man.

Johnson lived between 1600 and 1644, and was thus a professional contemporary as well as a fellow-royalist with William Harvey. He was born at Selby, Yorkshire, and after serving an apprenticeship of eight years, paying the necessary fees, and presenting a silver spoon, was admitted a freeman of the Society of Apothecaries in 1628. Johnson then set up as an apothecary at Snow Hill in the parish of St. Sepulchre and rapidly became the leading herbalist of his day, making numerous botanizing excursions, or, as he called them, "simpling voyages," to various parts of the country in order to identify and record the individual wild plants to be found there. He was a most energetic and industrious man, and was accompanied on these excursions by many friends whose names he duly records in his publications. Johnson's contributions to botany were continuous and progressive, and there can be little doubt that had he lived longer he would have succeeded in his evident purpose of compiling a complete list and description of the flora of his native country. His services, however, did not end with botany: Johnson's translation of the book of Ambrose Paré on Surgery was published in 1634, and was of such use to the surgical profession in this country that it was three times re-issued before his death.

Thomas Johnson was a Royalist, and when the Civil War broke out he was faced with the necessity of sacrificing either his principles or his business: for the feeling in London was so strongly in favour of the Parliament that in all probability he would have been arrested and his property confiscated had he remained there. Accordingly, in 1643, Johnson joined the King at Oxford, and at the Royal request the university admitted him to the honorary degree of "Doctor of Physik." Johnson, however, was a combatant, and became a lieutenant-colonel in the London Regiment raised by Marmaduke Rawdon, the city merchant and ex-train-band Captain who was knighted later by King Charles for his services.

The history of the defence of Basing or "Loyalty" House as it was called against repeated and prolonged attacks by the Parliamentarian forces has never yet been adequately described. The position was one of considerable importance, as it commanded the great West Road near Basingstoke and convoys could readily be intercepted even as far away as Hindhead. The Marquis of Winchester, who held Basing for the King, maintained the defence for over two years, and even continued to hold out after the defeats of the Royal cause at Marston Moor and Naseby; the place being stormed eventually by Cromwell on October 14, 1645. During the summer of 1644 the garrison, then heavily beleaguered, were so hard pressed for food and means of defence that an S.O.S. was sent to the King at Oxford. Colonel Gage, an officer with much military experience on the Continent, undertook the very difficult task of relief. With a comparatively small force most ably handled he evaded the Parliamentary troops who had been

specially stationed to intercept him, and on September 10, 1644, at seven in the morning in a thick fog fell upon a large body of the besiegers and assisted by a timely sortie of the garrison led by Colonel Johnson effected a triumphant relief and brought much-needed supplies of food, men, and ammunition to the garrison. It was during another sortie led by him four days later that Johnson received the wound in the shoulder from which he died. The account of this event in a contemporary account of the siege ascribed to the Marquis himself or his lady is as follows :—

"Lieutenant-Colonel Johnson Doctor of Physique was here shot in the shoulder, whereby contracting a Feaver he dyed a fortnight after his worth challenging Funerall teares, being no less eminent in the Garrison for his valour and conduct as a Souldier then famous throughout the Kingdom as an Herbalist and Physician."

Thomas Fuller, who served as chaplain at Basing during the siege and obviously knew Johnson well, has the following notice of him in his "Worthies of England," 1662.

"A man of such modesty that knowing so Much he would own to the knowledge of Nothing. The University of Oxford bestowed on him the Honourary degree of Doctor in Physick ; and his loyalty engaged him on the King's side in our late Civil Warre. When in Basing House a dangerous piece of service was to be done this Doctor (who publickly pretended not to valour) undertook and performed it. Yet afterwards he lost his life in the siege of the same House and was (to my knowledge) generally lamented of those who were of opposite judgment."

The diligent and learned authors of the present biography have performed a valuable service in reviving the memory of this excellent man. The book teems with botanical lore. While great pains are taken to verify data and to sift information concerning the birth of Thomas Johnson, there is silence concerning the place of his burial. As the church at Basing at that time was frequently in the hands of the besiegers and the scene of close fighting—the marks of bullets then fired can still be seen on the church door—it seems possible that Johnson was interred with other members of the garrison who fell in the siege in the orchard of Basing House. There surrounded by the old battered red brick walls the rich crimson of which glows in the evening sun, and in a garden of herbs, vegetables and flowers is a most fitting resting place for the bones of Thomas Johnson, whose memory is also preserved in a genus of Australasian plants named after him by the great botanist Robert Brown and called "Johnsonia."

Diseases of the Eye. By A. Rugg-Gunn, M.B.Edin., F.R.C.S.Eng. London : William Heinemann (Medical Books), Ltd. 1933. Pp. xii + 188. Price 12s. 6d. net.

This volume is one of the Practitioner's Series. In size and shape it is pleasant to handle, and it is very well printed, with a good wide margin to the text.

As stated in the modest preface, the aim has been to describe selected manifestations of disease of the eye in such a way as to emphasize their resemblance to disease elsewhere, and to render evident their common pathology. This is a point that certainly requires emphasis, for the attitude is common that disease of the eye is in some peculiar way an entity in itself, requiring the services of a specialist.

The selection is an excellent one, and includes all the common types of eye disease met with in general practice.

The opening chapters devoted to the conjunctiva, and the cornea and sclera, are rightly the longest in the book; they are very well done, particularly as regards treatment.

The general method of dealing with errors of refraction is excellent; it includes all the information required with a welcome absence of optics, and the short account of contact glasses should be of general interest.

Theories of glaucoma might with advantage have been omitted, and the method of determining the affected muscle in diplopia is unnecessarily complicated.

It is noted that the author is an advocate of the intramuscular injections of milk, a form of therapy extensively used on the Continent, but hardly to be recommended to the general practitioner.

The illustrations are good, but the frontispiece, showing the ciliary processes and zonule of Zinn, of purely academic interest, gives a false impression of the practical value of the contents.

This book should be popular with general practitioners, for it amply fulfils its purpose. R. M. D.

Notice.

OFFICERS' ADVISORY SOCIETY.

We have received the first number of *The Advisory Gazette*, published by the Officer's Advisory Society in April, 1933. The Gazette is intended to furnish to members of the Society useful information on various subjects, and to make the Society and its aims more widely known in Service circles. It is distributed to Naval, Military and Royal Air Force officers' messes, as well as to members of the Society.

The Officers' Advisory Society was formed with a view to obtaining for officers, serving and retired, advice in regard to civilian matters, such as taxation, house property, legal cases, and investments, and to assist retired officers in connection with their entering civilian life.

Field Marshall Sir Claud Jacob is chairman of the Council of the Society.

Members pay a joining subscription of 10s. and an annual subscription of 10s., or a life membership subscription of £5 which may be paid in five annual instalments of £1 1s. Information as to the Society can be obtained from the Secretary, Officers' Advisory Society, Royal United Service Institution, Whitehall, London, S.W. 1.

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The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a nom-de-plume.

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Great Britain

No. 2. August, 1933. Vol. LXI.

Journal

OF THE Royal Army Medical Corps

ISSUED MONTHLY

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VOL. LXI. AUGUST, 1933. No. 2

Journal of the Royal Army Medical Corps.

Original Communications.

ANTITYPHOID INOCULATION.

Observations on the variation of Bact. typhosum in vivo.

By BREVET-COLONEL H. MARRIAN PERRY, O.B.E., K.H.S.,

MAJOR H. T. FINDLAY,

AND

MAJOR H. J. BENSTED, M.C.,

Royal Army Medical Corps.

(*From the Pathological Department of the Royal Army Medical College, London.*)

IN a previous communication (Perry, Findlay, and Bensted, 1933), a number of confirmatory observations were made on the low degree of virulence of *Bact. typhosum*, strain Rawlings, maintained in the Vaccine Department of the Royal Army Medical College. The protective efficiency of this organism and that of a smooth recently isolated strain of typhoid bacillus was contrasted. As a result, it was concluded that assessed on the basis of the mouse protection tests employed by Grinnell (1932), this Rawlings strain had become in the course of time an indifferent antigen and, in its present phase, did not yield on inoculation the maximum degree of protection desirable.

The investigations on which these conclusions were based have been continued, and during this work some interesting aspects of bacterial variation *in vivo* have become apparent. The present communication is concerned with the variation exhibited by the typhoid bacillus when certain methods of *passage* are adopted, employing mice as the experimental animals.

Loss of Virulence.

That diminution in virulence of an organism usually follows its prolonged cultivation on laboratory media has long been known. The correlation, however, of virulence, and certain cultural, antigenic characters and immunogenic properties was not appreciated until the results of the studies of Arkwright (1921) and de Kruif (1921) became available. It is now generally accepted that smooth colonial formation, stability in saline suspension, and non-agglutinability by a pure R (rough) serum connote virulence. In contrast, rough colony formation, instability in saline suspensions, and agglutinability by a pure R serum are indicative of loss of virulence.

A good example of rapid diminution of virulence is furnished by *Past. pestis*. Almost coincident with its recovery from the animal body this alteration may be so extensive and complete that continual animal passage is the only method of maintaining the virulence. In the majority of organisms the change is more gradual and less marked and, although quite recently isolated cultures may show rough variants, no difficulty is experienced, as a rule, in conserving the original virulence by careful colony selection. On prolonged subculture the rough character tends to become predominant and increasing difficulty is experienced in recovering smooth organisms.

Under conditions of artificial culture *Bact. typhosum* exhibits a similar tendency to the above. Primary plate cultivation, in the majority of instances, manifests the virulence of the organism by the development of smooth colonies only. An explanation is later advanced for the occasional appearance of rough colonies on primary blood or fæcal culture, but smooth colonial formation is the rule. For a longer or shorter period, dependent on a variety of factors, the culture may preserve its essentially smooth character. At quite an early stage in its artificial cultivation, however, a proportion of the colonies may assume a slightly rough tendency. Strains of typhoid bacilli isolated during the Yorkshire epidemic, with which we have worked, had assumed this intermediate phase within a few weeks of their cultivation in an artificial environment, and field cultures had assumed a comparatively low degree of virulence due to the greater proportion of rough elements. It was pointed out by de Kruif (1922) that there was a relation between the virulence of a culture and the ratio of rough to smooth organisms it contains. If subculture is prolonged without the precaution of colony selection, the number of these rough variants gradually increases until a period is reached when this character becomes so predominant that the usual methods available for the development of smooth colonies fail.

The various stages described above have been well recognized by bacteriologists for a number of years and the evolution of the Rawlings strain of typhoid bacillus has apparently followed these lines. Originally isolated in 1900 (Leishman 1905), it has been subcultured continually at

very frequent intervals for a period of thirty-three years on ordinary laboratory media. It must here be emphasized that this culture, the source of the strain which has been so widely distributed to laboratories all over the world, has been most carefully maintained in the Vaccine Department of the Royal Army Medical College. For the last twelve years it has been in the sole charge of the same laboratory assistant who has not had access to any other strain of typhoid bacillus. Since the earliest days of the manufacture of typhoid vaccine in the Department it has been the routine to prepare the inocula from single colonies of this strain and unless the resulting growth showed uniform turbidity in broth the inoculum was discarded. Since the significance of saline/broth stability has been appreciated this colony selection has been more carefully followed. From the experience of previous workers in the Vaccine Department, and from personal knowledge of the culture, there appears to be little doubt that for eighteen to twenty years there has been difficulty in maintaining the strain in its smooth phase. Indeed, it is questionable if a true smooth colony has been separated during the last five years.

Most laboratory workers acquainted with the Rawlings typhoid bacillus are in agreement as to the predominance of its rough character. Grinnell (1932), studying twelve different cultures of the strain obtained from various laboratories in America, states that he finds them all in this phase. A similar view is also shared by English workers with whom this question has been discussed. Two cultures of the strain have, however, been received recently which are stated to have originated, at some indefinite time, from the Royal Army Medical College. One of these cultures had been maintained abroad. Not only do both of them produce definite smooth colonies that are antigenically pure, but they show little or no tendency to throw off rough variants. The virulence of these two organisms has been tested and is in sharp contrast to that of the original Rawlings strain. It is difficult to understand how these cultures have escaped the change that appears to have almost universally overtaken the descendants of the original organism.

Whilst this reduction in virulence under normal conditions of artificial culture is, in the case of *Bact. typhosum*, a gradual process, the change in many organisms can be accelerated *in vitro* by various well recognized methods. The most effective, perhaps, is by culture of the organism in its specific anti-serum (Griffith, 1923; Arkwright and Pitt, 1929). That this rapid change from the smooth to the rough phase can occur *in vivo* is apparent from observations made in the course of an extensive number of mouse inoculation tests. The experiments detailed below illustrate this point.

Experiment 1.

Object.—To ascertain any change that may occur in the organism when various smooth strains of typhoid bacilli are injected intraperitoneally into mice in doses slightly *in excess* of the minimal lethal dose. The criterion of a M.L.D.

being the number of bacilli that causes death from septicæmia in 100 per cent. of the mice employed within a period of forty-eight hours. (The M.L.D. of the organisms used had previously been determined to be in the region of 40 millions).

Ten mice were employed in the experiment and the inocula consisted of an eighteen-hour broth-culture of various smooth organisms which had been suitably diluted to contain a dose of 50 millions in a volume of 0·5 c.c. Five different smooth strains of typhoid bacilli were used, viz.: "Denby Dale," "Allahabad," "Malton 1," "Watson," and "Greenwood." Each strain was injected into two mice.

Within forty-eight hours all of the animals were dead and culture of the heart-blood yielded in each instance profuse growths of pure smooth colonies.

Conclusion.—From this observation it is evident that the dose of typhoid bacilli given is sufficient to overcome rapidly the natural resistance of the animal. In consequence an intense septicæmia is produced and heart-blood culture yields a rich growth of smooth organisms.

EXPERIMENT 2.

Object.—To define any change that may occur in the organism when the dose injected intraperitoneally into mice is *slightly less* than the minimal lethal dose.

Twenty-five mice were used for this observation. The same strains of organisms were employed as those in Experiment 1, the inocula were prepared in the same manner and the dose given was 30 millions. Each of these strains was injected into five mice. At the end of forty-eight hours eight mice, distributed over the five batches, had died and post-mortem culture of the heart-blood gave pure rich growths of smooth organisms. The remaining mice were evidently ill, but they had completely recovered in three days. At daily intervals up to the tenth day following inoculation one of these animals was killed and the heart-blood cultured. On each occasion up to the eighth day plate cultures yielded a scanty growth of rough colonies, subsequent to this heart-blood cultures were sterile. The variation in character of the organisms was common to all the strains employed.

Conclusion.—The intraperitoneal inoculation of a sub-lethal dose of virulent typhoid bacilli is overcome by the natural resistance of the animal. Although invasion of the blood occurs it would appear that the organisms are, in the majority of instances, more or less readily destroyed; the few bacilli that survive and are recovered by blood-culture in the course of this transient septicæmia have assumed a typically rough character. Animal tests with such organisms demonstrate their low virulence.

EXPERIMENT 3.

Object.—To confirm that alteration *in vivo* of the character of the organism may follow the administration of lethal doses of virulent bacilli, the death of the animal being prevented by artificially increasing the natural resistance by means of anti-typhoid serum.

Strain "Watson" was employed in this experiment as an eighteen-hour broth-culture as before. Five mice received 40 million organisms intraperitoneally (this dose killed control animals in less than forty-eight hours). One hour later each mouse was given, by intraperitoneal inoculation, 0·5 c.c. of a special therapeutic anti-typhoid horse-serum kindly placed at our disposal by Dr. R. H. O'Brien. At the end of eighteen hours all of the animals were obviously very ill and a second dose of 0·5 c.c. of the serum was administered. Four hours later one of the mice was killed and heart-blood culture yielded a very scanty growth of rough organisms. The remaining animals made a complete recovery and subsequent culture of the heart-blood was sterile.

Conclusion.—This observation provides further evidence of the change *in vivo* of the character of the organism from smooth to rough. The administration of anti-typhoid serum apparently provided the increased resistance which was adequate to deal with a dose of organisms usually found to be lethal.

The above experiments illustrate that the change in type from smooth to rough, which may be demonstrated by *in vitro* methods, can occur equally readily, given certain conditions, in the animal body.

Increase in Virulence.

Considerable difficulty is experienced in enhancing the virulence of an organism by artificial methods of laboratory culture. It is, of course, possible by frequent subculture, associated with colony selection, to assist in maintaining the original virulence of an organism. This method is only practicable when the bacillus has been more or less recently isolated and consequently contains a fair proportion of the smooth element.

The work of Arkwright (1921) and the experiments of Jordan (1926) provide examples of the derivation of smooth from apparently rough organisms by cultural methods. Their success in this respect was possibly dependent on the fact that the organisms they employed were in an early intermediate phase, and contained an appreciable quantity of the smooth factor. It has been our experience, working with the Rawlings strain of typhoid bacillus, that the change to rough has progressed to such an extent that all *in vitro* methods of transforming it back into the smooth type have failed. Our previous work with this organism has suggested that it is not antigenically pure. We have recently subjected the strain to a detailed analysis by cross absorption tests and it has become evident that whilst the rough element predominates a small proportion of the smooth persists. Attempts have, therefore, been made to effect the conversion of this strain of the bacillus to the pure smooth type.

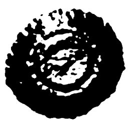
Primarily, *in vitro* methods were tried, rapid and frequent subculture in broth being the procedure adopted. This method of frequent

subculture was successful in the hands of Arkwright (1921) and Jordan (1926). The latter observer worked with single cell isolations, the organisms employed being strains of *Bact. paratyphosum* B recovered by blood-culture and maintained in the laboratory for a period of ten years. He was successful in obtaining colonies of the smooth type from a culture that was originally rough and proved that the resulting organism was increased in virulence in addition to its antigenic alteration. Working with the Rawlings strain of typhoid bacillus, which has been artificially maintained for thrice the above period, we have been unable to obtain a similar result in spite of repeated attempts. Whilst the colonial character of this strain may become altered towards smoothness, true variation cannot be confirmed by further tests. Such cultures are still mainly antigenically rough and on mouse inoculation prove to be of low virulence. Further attempts to influence this change by frequent subculture in normal serum broth (Rowland, 1914) were also unsuccessful, and it was concluded that the virulence of this organism could not be enhanced by artificial cultural methods.

Animal passage has been employed successfully with a variety of organisms for many years as a means of increasing the virulence. For instance, the virulence of *Past. pestis* is readily maintained by this means. Similarly, the virulence of rough strains of *Past. leptiseptica* was raised by de Kruif (1922), and that of the pneumococcus by Griffith (1928), by passage through the animal body. That failure, however, may result even though *in vivo* methods are employed is evident from the inability of Bruce White (1925), by this procedure, to effect the transformation of a rough salmonella organism to the smooth type. This observer passaged the organism through mice, guinea-pigs, and rabbits and, as a result of his failure to bring about the alteration, formed the opinion that "rough variation is probably a permanent and irreversible change." In the experiments to which reference has been made it is not clear that the organisms employed were antigenically pure. The fact, already mentioned, that the Rawlings strain of typhoid bacillus, although predominantly rough, contained a small quantity of the smooth factor suggested that this element might be increased by certain methods of animal passage.

As a preliminary, a number of mice were injected intraperitoneally with massive doses (over 1,000 million organisms per c.c.) of this strain. Death invariably resulted in a period of twenty-four to forty-eight hours and the heart-blood was cultured. In all cases the organism isolated was as rough in every respect as that introduced. Repeated attempts by this method to induce any tendency towards smoothness consistently failed.

The following experiment was made because it was considered that death of the animals was produced so rapidly that any selective influence exerted on the organism might not have had an opportunity to produce its maximum effect.

Original Rawlings strain as maintained at the R.A.M. College.	Rejuvenated Rawlings strain
	
Photograph of colony showing typical rough character (x 6).	Photograph of colony showing typical smooth character (x 6).
Antigenically impure - rough element predominates.	Antigenically pure - smooth element only.
'O' agglutination indifferent. 'R' agglutination good.	'O' agglutination good. 'R' agglutination absent
Agglutinin response to 'R' and 'O' elements.	Agglutinin response to 'O' element only
Virulence low.	Virulence high
Mouse protection efficiency poor.	Mouse protection efficiency high

EXPERIMENT 4.

Object.—To determine the effect of an intraperitoneal inoculation of the Rawlings strain of typhoid bacillus in influencing its change from the rough to the smooth type when the dose is just sufficient to kill mice in twenty-four to forty-eight hours.

Three mice were injected with 500 million organisms of this strain grown in broth for twenty-four hours (this was the previously determined minimal lethal dose). The next morning the animals were dead and heart-blood culture yielded a moderate growth, consisting largely of rough colonies, together with a smaller number of colonies that showed a tendency towards smoothness. One of these colonies was selected, cultured in broth for eighteen hours and its virulence tested. It was found to be lethal to mice in twenty-four hours in a dose of 100 millions, and cultivation of the heart-blood of these mice yielded profuse growths of pure smooth colonies that consistently killed mice in a dose of 40 millions.

Conclusion.—The intraperitoneal inoculation of a culture of typhoid bacilli of a low degree of virulence in a dose just sufficient to cause death of the animal in twenty-four hours produces, apparently by selection, a true change in type from rough to smooth.

This experiment has been repeated on a number of occasions with larger batches of mice and has, as a rule, given similar results. Whilst, by passage through two animals, the virulence may be raised to the extent detailed above, in certain instances further passage and colony selection may be necessary. On the other hand, on one occasion, we have been successful by a single passage only in raising the virulence of the Rawlings strain to an extent when it will kill mice in a dose of 30 millions.

Discussion.

The observations on variation of the smooth to the rough type of *Bact. typhosum in vivo* when smooth cultures of this organism are injected intraperitoneally into mice are confirmatory of the *in vitro* experiment of the effect of cultivation of an organism in this phase in a specific immune serum. In addition, they possibly explain the occasional appearance of rough colonies on primary blood or fæcal culture in certain cases of typhoid fever in man. It appears that when infection with a smooth organism occurs the change from smooth to rough results in the animal body if the natural resistance is sufficiently high, or has been artificially raised. The extent of this change is dependent upon the balance between resistance to infection and the virulence of the organism.

The reverse change from rough to smooth is of practical interest from the point of view of successful vaccine prophylaxis against typhoid fever. It can be accepted that the protective capacity of a vaccine is related to the virulence of the strain of organism injected. In default of some method

of maintaining this virulence at a sufficiently high degree continual substitution by fresh strains becomes advisable.

The marked diminution in virulence of the Rawlings strain of typhoid bacillus, together with its indifferent immunizing properties in so far as mouse protection is concerned, compelled us to advocate the inclusion in the typhoid vaccine of a more recently isolated strain. It was evident, however, from mouse experiments that the Rawlings strain could still elaborate a certain degree of immunity. The explanation is to be found in the fact that serological analysis proves that it still contains a small proportion of the smooth element. The production of appreciable amounts of "O" agglutinins resulting from its injection into man and animals confirms this view.

It is now apparent from the mouse experiments that have been detailed that rejuvenation of this senile strain can be effected by certain *in vivo* methods. By such methods the original Rawlings strain has been so transformed that its virulence is possibly of a higher degree now than when it was originally employed as a typhoid vaccine. At the present time it is not possible to state how permanent this change may be, no alteration in this respect, however, has been noted during the last two months. It has also been ascertained that this smooth Rawlings strain is as effective in protecting mice as any of the more recently isolated strains with which we have worked. Possibly, further investigation may prove its superiority in this respect, and these comparative estimations are in progress. It is, however, questionable whether so highly virulent an organism is suitable for inoculation into man. In addition to the criterion of its protective properties, antecedent experience should prove that its administration is not followed by severe after-effects. The strain of typhoid bacillus (Allahabad) at present included in the Army vaccine was subjected to extensive trials, both from the protective and reaction aspects, before its selection was approved. Until such time as more experience is obtained of the after-effects of the inoculation of this smooth Rawlings strain into man it is not proposed to include it in the typhoid-paratyphoid vaccine.

Summary.

(1) Antigenic variation of strains of *Bact. typhosum* can be effected by *in vivo* methods, employing mice as the experimental animals.

(2) The change from smooth to rough has been brought about by intraperitoneal inoculation of a dose of organisms that is just sub-lethal. Rough representatives of the smooth strains have been obtained by heart-blood culture from the third to the eighth day following inoculation.

(3) Whilst the reverse change from rough to smooth fails when massive doses of the rough organism are injected, a method is described by which smooth colonies of proved antigenic purity have been obtained from such variants.

(4) Comment is made on the practical application of these observations to the manufacture of typhoid vaccine.

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QUININE PROPHYLAXIS IN NORTHERN INDIA.[1]

By Major T. YOUNG,
Royal Army Medical Corps.

I.—Introduction.

Of all the diseases that affect mankind, malaria is probably the commonest, and its ravages are widely distributed throughout the world. It is estimated [1] that 80,000,000 cases of malaria occur annually in India, and that about 4,000,000 die from "fevers," in a third [2] of whom the cause is considered to be malaria. Apart altogether from the mortality of the disease, malaria exacts a high toll from the country in which it is widespread and severe, for it saps the vitality of its people, destroys the life of the country, and is a potent factor in high infantile mortality. Its economic importance is enormous, and delayed development in every line of progress can safely be attributed to it. It would be a mammoth task to endeavour to estimate the economic loss on account of malaria to a country such as India. Hospital treatment of cases, nursing, medicines, invaliding, training men to take the place of those invalided, work days lost owing to this malady and other ailments directly and indirectly attributable to it, anti-malaria measures, are some of the items which would help to make up the bill.

Dr. Andrew Balfour [3] estimated the direct annual cost of sickness and death resulting from malaria as between fifty and sixty million pounds exclusive of the further vast loss due to industrial inefficiency.

The economic importance of this disease is also evidenced by the results of anti-malaria measures in Preston, U.S.A., since 1926 [4]. These measures included the use of quinine as a cure (in lay hands in all but serious cases) and the use of plasmochin as a preventive of mosquito infection.

Figures are as follows :—

	1925	1926	1927	1928	1929
Hospital admission rate for malaria —primary diagnosis only	242	135	100	37	18
Average cane cut per man per day ..	Less than 1 ton	Less than 1 ton	1·23 tons	1·39 tons	1·61 tons

Not only has the sick rate been steadily reduced, but there has been a progressive increase in the work output per man.

Again, in 1906, in Malaya, Watson [5] found that in certain estates the economic effect of quinine administration was that the small labour force

[1] Published with the permission of the University of Glasgow, to whom the article was submitted as a Thesis for the degree of M.D.

was able to maintain the estate in perfect order. The improvement in health was not due to other causes.

Even in the British Army in India the sick wastage from malaria is very high. In the year 1929 [6], out of an average strength of 55,628, 6,454 cases were admitted to hospital, a ratio of 116 per 1,000, and this is the lowest figure, with one exception, viz., 1928, since the Great War. Happily, in such a highly selected body of men so well fed, housed, clothed and medically treated, the death-rate is small—0·13 per mille in 1929. Nevertheless the disease is of very serious moment, and in the malaria season in an epidemic year the possibility of a campaign in certain areas on the Frontier would be viewed with the gravest concern.

Many cases are on record where malaria has decimated an expeditionary force. The ill-fated Walcheren Expedition of 1809 is a well-known example. In spite of protests from the medical authorities, a force was despatched in late summer and autumn, when the malaria season was at its height. Soon an epidemic of appalling magnitude was in progress, so that by the middle of September it was estimated that two-thirds of the force were sick [7]. The Army, which left about 12,000 strong, returned to England in December decimated and broken. There were only 247 casualties from fighting, but over 4,000 died of malaria.

The French Madagascar Campaign of 1895 suffered a similar fate. It lasted but ten months, and in that time, 5,600 died of disease, chiefly malaria. The strength of the forces was 18,000, and only 7 were killed in action.

It is abundantly clear, therefore, that the success of a campaign in a malarious country is largely dependent on the efficacy of the anti-malaria measures adopted. The truth of this was again brought home during the Great War, when in Salonika in the first season there were over 30,000 cases amongst British troops [8]. Also in Palestine during the last great advance from the River Auja the sick wastage due to malaria was enormous. For months before the advance the line had been more or less stationary, and an intensive anti-malaria campaign had been in progress, consisting chiefly of anti-mosquito measures and protection from the bites of mosquitoes by the use of mosquito nets. When the advance began, mosquito nets were carried, but often not used, and the troops suffered heavily in their passage through intensely malarious country, till then in enemy occupation and where anti-mosquito measures were unknown.

In 1926 I was faced with a malaria problem, and fortunately on this occasion I was in a position to test the efficacy of quinine prophylaxis.

I was stationed in a small "outpost of Empire" in the North-West Frontier of India, with a strength of about 1,700 British and 3,000 Indian troops. The number of British troops was reduced to about 600 throughout the hot weather, as many as possible being sent to "cold storage" in the hills to save them from the heat of the plains, and to reduce as far as possible the numbers exposed, and the period of exposure, to malaria infection. Early

in the season I commenced a malaria survey and opened an intensive anti-malaria campaign. The work proceeded well, and mosquitoes and malaria were negligible. During August and the first ten days of September, however, sixteen inches of rain fell (the average annual rainfall is fifteen inches), and when I returned from leave early in September the cantonment was flooded and anopheles, including the noted carrier *A. culicifacies*, were breeding everywhere. No stone was left unturned in our efforts to reduce mosquito breeding, but it was obvious that a severe epidemic was probable.

This was brought home during the last ten days of September, when 58 cases of malaria were admitted to hospital out of a total British garrison of about 600 strong. All anti-malaria measures known to us and available locally were being tried. Pools were drained or filled in where possible. Elsewhere cresol was added, paraffin crude oil mixture sprayed on the surface of the water, or Paris green distributed with a blower.

Routine oiling of wells was carried out, and diggies and tanks were emptied weekly or treated with oil. Numerous traps were set for mosquitoes, and barracks were sprayed or fumigated periodically. Individual protection was afforded the troops by forbidding the use of shorts and short-sleeved shirts after sundown, by the liberal use of P.C. oil (paraffin and citronella) on all exposed parts, and by strict mosquito-net discipline both as regards use in bed and condition of repair. But in spite of all our efforts there was no reduction in the number of malaria cases admitted to hospital or in the number or variety of anopheline mosquitoes caught in traps.

The question of quinine prophylaxis was then considered. It was useless to ask for permission. Quinine prophylaxis has been thrown overboard so far as official military medicine is concerned, chiefly as a result of the failure of the process in Salonika during the Great War. Also time would be necessary. So I decided to carry out a controlled experiment during October on just under 500 men and to report the result afterwards. Local combatant opinion was very favourable, though considerable persuasion had to be used before the necessity for a control was fully appreciated. Though admittedly the trial was on a small scale, the results duly reported, were considered sufficiently encouraging, and I was officially instructed to continue the experiment the following year and on a larger scale.

Towards the end of the second season I was given an appointment in which I had control of the health organization of troops in a larger area. So in 1928 the scope was further extended. We gained further experience in 1929, when my area was affected by a severe epidemic of subtertian malaria, and it was hoped that the knowledge then acquired would be put to a final test in 1930. However, the opposition to controls, which had been gaining strength throughout, eventually outweighed my efforts for a final test, and orders were received that all troops were to be given "prophylactic quinine," and that controls would not be allowed, as it was considered that the process was definitely beyond the experimental stage, and the case for quinine prophylaxis was quite definitely proved. While

it was satisfactory to know that one's superiors were convinced, I would infinitely have preferred to have used controls, even in small numbers only, for another year. My protests, however, were in vain.

The whole subject of quinine prophylaxis is a very controversial one, and different opinions are expressed by different authorities in no uncertain fashion, often, it seemed to me, on scanty evidence.

The experiment about to be described has been carried out over a period of four years during which it has been fully controlled. In the fifth year there were no controls. Many thousands of troops, British and Indian, were affected. Some were new arrivals, others were old campaigners. Commencing in one station, the scope was extended to many stations, with widely different climates, in the plains and hills of two districts of the North-West Frontier Province.

It is hoped that from the evidence produced it will be possible to arrive at a conclusion as to whether quinine prophylaxis has, in certain circumstances, a definite place in our war against malaria.

II.—Historical.

Malaria is probably as old as man. It was well known to Hippocrates in the fifth century. He recognized three types of fever, tertian, quartan and quotidian, and differentiated these types from continued fevers. It is interesting to note that as early as the first century it was suggested by Varro that these fevers might be caused by swamp air. The term malaria (*mal* bad and *aria* air) was not introduced till early in the eighteenth century, when it was firmly believed that the disease was due to miasmata.

Though malarial fevers were well known to physicians and writers throughout all the intervening centuries, material additions to our knowledge have only been made during the past hundred years. In 1847 Mickel demonstrated that the dark colour of internal organs in malaria was due to pigment, and in the following year Virchow showed that the pigment was contained in cells. Kelsack in 1875 observed pigmented bodies in malarial blood and later (1880) concluded that these pigmented cells (melaniferous leucocytes) were diagnostic of malaria.

Meanwhile the first step towards the discovery of the parasites was made by Lancaster, who in 1871 was the first to discover a protozoal parasite living within a red blood-corpuscle in a frog.

This was followed in 1889 by the most important discovery in the history of malaria, when Laveran, a French Army Surgeon, described a number of the stages in the life history of the malaria parasite, viz., the amœbula, merozoite and "flagellate" bodies.

The next step was made in 1897 by MacCallum who, working in Baltimore on *Hæmoproteus columbæ*, the parasite of pigeon malaria, was fortunate enough to see a microgamete break off from a "flagellate" body, swim rapidly towards a spherical body and conjugation take place.

Meanwhile Manson had in 1884 traced the earlier stages of the development of *Microfilaria bancrofti* to its infective form in the thoracic muscles of *Culex fatigans*, and as a result had formulated the hypothesis of the mosquito transmission of malaria.

Major Ross showed that Manson's view was correct. In 1897 he demonstrated that in certain dappled wing mosquitoes (anopheline) fed on cases of malaria, malaria parasites with the characteristic pigment could be seen in the stomach wall. The following year, working in India with a malarial disease of sparrows (proteosoma), Ross found that if culicine mosquitoes are fed on the blood of infected sparrows, the parasite enters the stomach wall, grows and sporulates there with the production of sporozoites which subsequently enter the salivary glands. The insect is then capable of infecting other birds.

Ross's observations on bird malaria were soon confirmed on human parasites by Grassi.

The story was finally completed by Schaudinn who observed the penetration of a sporozoite into a red blood-cell.

As is so often the case in the science of medicine, the cure for malaria was discovered before the cause. In 1638, Countess del Cinchon, wife of the Viceroy of Peru, was cured of intermittent fever by "Jesuits' bark," which was introduced into Europe in 1640. Hence the name "cinchona."

Morton and Sydenham noted the action of cinchona in certain fevers, and in 1753 Torti wrote his classic account of malarial diseases and by the use of cinchona showed how to differentiate clinically those fevers which were cured by cinchona from those which did not yield to this specific.

It was not until after 1820 that quinine was introduced, and its use did not become general till the second half of last century. Even now we have still much to learn regarding the chemistry and pharmacology of the different alkaloids and derivatives of cinchona bark, and also as regards their absorption, metabolism, method of excretion from the body, and their action on malaria parasites. Not until these points are settled shall we be able to express definite and reliable opinions on many of the problems affecting the administration of quinine in the cure and prevention of malaria.

In spite of the number of substitutes which have been tested in recent years, quinine remains our sheet anchor in the fight against malaria. India without quinine would be in a sorry plight. In endemic areas the death-rate from malaria would be far above the present high figure and many of the survivors would be physical wrecks suffering from malarial cachexia and endeavouring to build up a natural immunity. Meantime they would swell the reservoir of infection.

Quinine has its limitations, but according to Professor W. E. Dixon, F.R.S. [9], we are only touching the fringe of the pharmacology relating to quinine derivatives. The chief shortcomings of quinine are: (1) that however thorough the dosage many cases of malaria subsequently relapse;

(2) that frequently in primary cases of malaria the temperature does not fall for several days, though the Tauret acid test of the urine shows that the quinine is being absorbed; (3) that quinine appears to exert no effect on the sexual forms of the parasite; (4) that in many cases quinine will not cure an attack unless the patient is confined to bed.

Apart from the above limitations, failure to obtain good results is usually due to faulty administration, e.g., use of unsuitable salts or insoluble tablets, dose of drug ordered not being consumed, or non-absorption by the patient.

Laveran's statement is as true to-day as when it was made many years ago. "If quinine is given in adequate doses properly administered, the diagnosis is at fault if the fever does not yield by the fourth day."

"Very little quinine is absorbed in the stomach no matter what salt is swallowed as it passes on into the duodenum where it is precipitated as amorphous quinine base and is absorbed by the aid of the bile" [10]. From the alimentary canal it passes into the blood where most of it is rapidly taken up and destroyed by certain organs, e.g., liver, spleen, kidneys, suprarenals and brain.

A proportion of the quinine is excreted unchanged in the urine, where it may appear within ten minutes of consumption. Concentration in the blood is at its maximum after four to six hours. It is rapidly eliminated for the first six hours and the bulk, probably about three-quarters, has been excreted within twelve hours. The more soluble salts are relatively more rapidly absorbed and also more rapidly excreted from the body.

Quinine prophylaxis is the regular taking and absorbing of quinine in such a manner as to prevent paroxysms of malaria.

Strictly speaking this is not prophylaxis, for as Yorke and Macfie [11] demonstrated in G.P.I. cases experimentally infected with malaria, quinine given before the infecting feed is useless. The process would be more correctly designated "Early Treatment." Yorke and Macfie showed that unless quinine was continued for ten to fourteen days after an infective feed, infection develops. They considered that there was good reason for believing that quinine fails to destroy all, if any, of the sporozoites.

Infection is not prevented. It is cured or restrained. The multiplication of malaria parasites is prevented or retarded. In many cases an attack may be prevented, in others cessation of quinine may be closely followed by a paroxysm, and in some the "prophylaxis" may appear to be ineffective or the check on the propagation of the parasites may be too slight to prevent the occurrence of malaria attacks while quinine is being administered.

Many years before the discovery of the malaria parasite and of mosquitoes as carriers of malaria, quinine prophylaxis was recognized as an effective preventative of intermittent fevers. As long ago as 1760 Europeans living on the coast of Guinea used cinchona bark powder continually during the rainy season when fevers were prevalent.

Most residents in tropical countries, planters and big game hunters lay

great store by quinine prophylaxis and in some parts of Africa, where malaria and blackwater fever take a heavy toll of life, every European infant receives two grains of quinine daily from birth, seemingly with benefit and certainly without appreciable hurt.

The measure, however, fell into disrepute during the Great War, chiefly as a result of its apparent failure to check malaria in Macedonia [12].

This is partly explained by the failure of the French, recorded by V. Nicolet; widespread evasion occurred, for the lessening of which medical units had to be organized to detect the culprits by surprise examinations of their urine for the excretion of quinine.

Throughout the war, on the different fronts where malaria prevailed, quinine was extensively used as a prophylactic. There appears to have been no consensus of opinion as to its value, but the evidence generally was against the practicability of its use as a prophylactic under war conditions where bodies of men may be dispersed and without the necessary supervision to ensure that the drug is actually taken.

In the Navy, however, during the war, P. Bassett Smith records the undoubted value of prophylactic quinine, if only to enable the infections to be so reduced as to lessen materially the loss of man power.

The results obtained by some authors are in marked conflict with those obtained by others.

Stitt [13] records the following: "398 marines served in 1906 for about one month on the 'Isthmus' of Panama, during which time they were given nine grains of quinine daily as a prophylactic.

"During this month there was only an occasional case of malaria among the men. At the end of the month 298 of the original 398 returned aboard ship and sailed for the North. Two days later 20 cases of malaria developed, followed the next day by 54, and the day following by 45. The medical officer then resumed ten grain prophylactic doses for those not down with malaria, but notwithstanding this there were 215 acute malarial paroxysms, some of them of pernicious type, among 298 men.

"It was noted that these men did not respond satisfactorily to quinine treatment even when the drug was administered intramuscularly."

The fate of the hundred men who remained in Panama is not stated. It is interesting also to speculate as to what would have been the effect of continuing the quinine prophylaxis from embarkation for a period of ten days.

Stott's observations [14] are very interesting. From October 1, 1911, to September 10, 1912, he carried out a controlled experiment in the 91st Punjab Regiment using the odd halves of each double company as the experimental group and the even halves as the control. For the first two and a half months fifteen grains of quinine sulphate in acid solution were given thrice weekly. During the next two months, the non-malarial season, no quinine was given. For the remainder of the period ten grains of quinine were given thrice weekly. The results showed:—

(1) There was no material difference in the malaria incidence in the two groups.

(2) The course exercised no practical influence on the severity of a subsequent malaria attack.

(3) Exhibition of quinine did not render the diagnosis of cases more difficult.

(4) If prophylactic quinine fails when its issue is as carefully administered as is ordinarily possible in a regiment, this particular method cannot be expected to succeed when distributed broadcast amongst an undisciplined rural population.

Hanschell [15] observing 29 men in the Belgian Congo in 1915-16 found five grains of quinine daily (bisulphate tablets) ineffective in preventing malaria. Twenty men slept under eighteen-inch nets and all contracted malaria, while none of the remaining nine who slept under three-feet nets caught the disease.

More recently (1930) Boyd [16] at Ferozepur had unsatisfactory results, and Harris [17] at Hong Kong did not observe any beneficial results during the administration to troops in camp, in the season 1930-31, of ten grains of quinine sulphate nightly and for ten days after their departure from camp. It is not stated whether this latter experiment was fully controlled, but a feature of interest noticed was that ten grains of quinine can be taken daily for a period of six weeks with practically no opposition and without the least ill effect by men doing very hard physical work.

While admitting that quinine will control the case rate in active malaria sickness, Williams [18] considers that the results are not sufficiently striking to warrant an extension of its use, on account of its unpopularity and the fact that it needs much time and supervision.

In an investigation of a small number of cases Treadgold [19] concluded that in Macedonia quinine alone was quite unable to prevent malaria. The same observer analysed 201 original papers and found that 134 of the writers favour quinine prophylaxis, 27 favour it with reservations, and 40 are against it. Those who advocate its use include such well-known and experienced workers as Celli, Koch, Ross and James, to mention only a few.

"Week-end prophylaxis" was advocated by H. Seidelin [20] in the Belgian Congo. He gave one gramme of quinine bihydrochloride on each of two successive days each week, and concluded that sickness due to malaria was diminished, that not only was the incidence of the disease decreased, but the infections occurring were milder, and that only 0·3 per cent. of working days was lost.

Other observers in the same district report similar findings. P. Walravens [21] advises that all children in that region should be given quinine from September to April; and F. van den Branden and L. van Hoof found that considerable benefit accrued to those who took quinine once weekly, even with some irregularity, throughout the season. In Sumatra, J. A. Hendriks lays much stress on quininization of the people especially as applied to schools. Rogers also records that in an extremely malarious part of New Guinea during an expedition, quinine failed to

prevent infection, but the general mild nature of the attacks was considered to be due to the drug, enabling the work to be completed.

Gosse [22] had good results from a small but well-controlled investigation in Mesopotamia. He suggests that good or bad results may depend on the intensity of infection, small doses of quinine being of more apparent value when the number of infected bites daily is small.

Watson [23] voices a similar opinion, and Rosenau [24] states that good results have been obtained on the Isthmus of Panama by the use of moderate doses, 3 to 6 grains daily. When the disease increases in prevalence or virulence the amount is raised to 8 or 10 grains per day, then dropped to 4 or 5.

Italian opinion is strongly in favour of quinine prophylaxis. Thompson [25], in an interesting description of various schemes of "bonification" and "integral bonification," shows that the State arrangements for quinine treatment and prophylaxis brought about a rapid and continuous decline of malaria mortality from about 500 per million in 1900 (the year in which the State Quinine Law was promulgated) to only 61 in 1923.

Grasse [26] has recorded good results in marshy parts of Tuscany, and in North Italy and Switzerland Galli Valerio records that the main element in bringing about the disappearance of malaria from certain foci was the administration of quinine.

In Palestine, Kliger [27] reported that the regular administration of thirty grains daily for five days followed by ten grains daily till the end of the malaria season in November reduced the loss of working days to less than one-sixth of the loss of those not taking the drug, but a fourth showed parasites four days after ceasing quinine, the infections being masked and work possible.

The Sergent brothers [28], as a result of their great experience in Algeria, concluded that although quinine is not an absolute protection against infection, still it should be taken daily as it renders the attacks milder and the infected less dangerous to their fellows. They found its wholesale use to be readily acceptable, not troublesome and sufficiently effective.

Probably the success or lack of success is largely determined by the thoroughness with which the quinine administration is carried out. In certain jail experiments in India [29] very good results were obtained where the administration was rigidly controlled.

The case for quinine prophylaxis may be fittingly concluded by a reference to the work of Watson [30] who, working in Malay, found after twenty years' experience that quinine given regularly reduced the sick-rate and death-rate if given in sufficient doses (less than six grains daily are of little value where malaria is intense), but that the use of quinine does not cause any material reduction in the liability to infection. He considers, however, that quinine systematically given probably assists the infected to acquire a natural immunity.

(To be continued.)

ALUMINIUM VESSELS AND FOOD CONTAMINATION.

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The approach to this problem is two-fold: physiological and chemical. An admirable survey of the known physiological data was prepared by Dr. J. H. Burn in March, 1932, in his report on Aluminium and Food, a summary of which appeared in the January issue of this Journal.

This report shows that where human beings (or animals of similar digestive make-up) ingest large quantities of aluminium over considerable periods, most of the aluminium is rapidly excreted, there is no resorption of aluminium from the intestinal canal, and no ill-effects follow, even where the quantities consumed far exceed practical maxima.

Injection experiments are, of course, beside the point; as Dr. Burn points out, an intravenous injection of magnesium sulphate will produce narcosis followed by death, even when the amount injected is very small.

The results of the experimentation on dogs carried out by Schaeffer, Fontes, Le Breton, Oberling and Thivolle in 1928 can be dismissed, as these observers made no control experiments, and the work of their compatriots overwhelmingly negatives their findings.

In addition to the data included in Dr. Burn's report, an elaborate series of tests on more than one hundred guinea-pigs has been carried out at the Mellon Institute of Industrial Research, under the direction of E. W. Schwartze, M.D. [2]. The conclusions arrived at are interesting.

Known amounts of aluminium up to 1,167 parts per million of consumed food were administered for about eighteen months (the life cycle of the guinea-pigs) and after the pigs were killed by etherization and examined chemically, tissue deposition was found to vary from 0·5 to 2·5 parts per million. The analytical determination of such small quantities of aluminium was done by a very accurate method to be described below. In addition, the amount of aluminium deposited in the soft tissues is independent of the amount fed. This is very nearly true also for the deposition of aluminium in the bones.

It is clear that so far as guinea-pigs are concerned, there is a minute maximal retention of aluminium in the tissues of 2·5 parts per million, which is not exceeded, however large the dose administered. The retention of this aluminium in no way affected the health of the guinea-pigs which were alive at the end of the feeding period. Whether it would be permissible to assume that the above relation holds good for human beings is another matter, but the results are very suggestive.

Of the work referred to above, none answers the queries which arise as to the suitability of aluminium utensils for use with foodstuffs, whether for cooking purposes or for holding foods or beverages over periods of time

The investigations show, however, the quantities of aluminium which can be administered to human beings over considerable periods without harm, and also what proportion of the dosage taken is retained.

The problem reduced itself, therefore, to determining whether the amounts of aluminium which may be dissolved by foodstuffs from utensils, exceed the quantities administered without ill-effects in such experiments as for example those of Drs. Chittenden, Taylor and Long [1A], in 1914.

Those experiments, which were carried out directly on human beings over a period of some ten months, showed that no ill-effects of any kind were produced by daily doses of alum up to an equivalent of 200 milligrammes of aluminium per diem. Assuming the daily balanced ration to have totalled 2 kilogrammes, the amount of aluminium administered represents 100 parts per million. Further, for even very heavy doses such as 1,000 milligrammes per diem, no ill-effects were found beyond some catharsis. On the same basis, this represents a dosage of 500 parts per million. Incidentally the catharsis produced in these latter experiments can with fairness be attributed to Glauber-salt residues from the alum baking powder used. This factor should be absent from experiments on removal of aluminium from utensils by foodstuffs. The purpose of this paper is to show that good evidence exists for believing that the amounts of aluminium removed by cooking are minute as compared with the above cases, being (according to the latest experiments [3], which appeared after the publication of Dr. Burn's report) of the order of 5 milligrammes per diem for a representative diet. The total weight of the balanced ration selected being 2·38 kilogramme, this quantity represents 2·1 parts per million of aluminium contributed by the utensil per diem. This is in good agreement with Massach's results [1] which gave a daily figure of 7 milligrammes of aluminium, and also with von Fellenberg's work in 1931, from which he calculates a daily ingestion of 8 to 10 milligrammes [4].

The validity of these conclusions depends essentially on the reliability of the analytical methods used for the determination of small amounts of aluminium when associated with large quantities of organic or biological matter. The technique of such determinations is eminently difficult and is only to be undertaken by expert chemists. Conclusions drawn from physiological experiments on excretion and absorption are valid only in so far as the analytical methods are accurate.

Earlier investigators relied on the losses in weight of aluminium strips when suspended in different foodstuffs subjected to heat for varying periods. Lunge and Schmidt (1892) [5] found that strips of aluminium exposed for six days to food acids of strengths ranging from 1 to 5 per cent., lost 1·08 to 4·77 milligrammes per 100 square centimetres of surface. For a saucepan of say 6 inches diameter and filled with liquid foodstuff to a depth of 3 inches, this would represent a removal in six days of 6 to 28 milligrammes of aluminium, 2 to 10 milligrammes of which would come

from the base of the pan. The loss for three hours' cooking—a reasonable practical period—would be 0·35 milligramme, or barely more than one-hundred-thousandth of an ounce. Similarly, for an ordinary water-bottle the amount removed would vary from 6 to 30 milligrammes or a daily average of 6 milligrammes or one five-thousandth of an ounce. These investigators also found that beer or tea did not attack aluminium.

Quam, in 1929, found that milk did not affect aluminium even up to a temperature of 70° C. Above 70° C. there was a minute loss of 0·12 to 0·18 milligramme per 100 square centimetres. These conclusions were confirmed by Chiaria in the same year, except that above 70° C. the latter found a slight increase in weight due to a film of metal-albumin compound. All these experiments confirmed the inactivity of milk and aluminium found by von Fillinger as early as 1908. In 1929 also, Mrak and Cruess found that fruit juices caused only small degrees of corrosion. In 1931 Colobraro took a litre of various food materials and boiled each in aluminium utensils for one hour.

The losses were as follows :—

Food	Loss in mg.
Milk	1·69
Olive oil	5·0
Sugar solution	2·0
Compote	9·54
Tomato preserve	45·6
Broth	1·2
White wine	1·83

From the above we can see that a quart of milk boiled for two minutes would dissolve 0·06 milligramme or two-millionths of an ounce, an infinitesimal amount. The agreement between these various investigators is very good, but too much stress must not be laid on results obtained by this method of approach, as various assumptions have necessarily to be made regarding distribution, etc. They are in accordance, however, with later work done by the next line of approach to be discussed.

The soundest method of attack is to analyse foods for increase of aluminium content arising after they have been cooked in aluminium utensils in the way that would normally be employed in the household.

Various experiments in 1913 have been recorded in the *Lancet* [6], but these were mainly qualitative. In the second series, Glaister and Allison [6B] found 1·018 grains of aluminium hydroxide were removed by 2.5 pounds of marmalade. This is equivalent to twenty parts per million of aluminium. The method of analysis is not recorded, which is to be regretted as detracting from the value of the findings. Both the *Lancet* Laboratory and Glaister and Allison acquit aluminium from being sensibly corrosible by water, weak acids, tomatoes, bacon, beefsteak, vegetables, etc.

In 1930, le Hunte Cooper [7] quotes in his pamphlet on the contamination of food by aluminium work done under the supervision of Dr. Eastes of Harley Street. The sole quantitative estimations of aluminium itself

which are referred to are as follows: Milk, 140 grains per gallon (or 2,000 parts per million); soup of mutton, potatoes, onion, and carrots and ½ gramme salt, 300 grains aluminium per gallon (4,300 parts per million). The soup had been allowed to stand for twenty-four hours.

There are references to the extraction of small amounts of material from gooseberries, rhubarb, lemonade (three lemons per half litre) and tap-water (one litre), but how much of this detachable matter was actually aluminium is not described. Nor is the method of analysis mentioned, and this omission rather invalidates the results quoted. The gelatinous extracts were found to contain aluminium, calcium, iron and silica, and we presume that these masses were treated by one of the gravimetric methods, usually employed till last year, the usual procedure being to precipitate the aluminium as the neutral phosphate. This method (Carnot's) is quite unreliable—as has been recently discovered—if calcium is present in appreciable quantities. The pH must be most strictly controlled. It was shown by Gwyer and Pullen in November last that the pH must be kept at 4·0 to 4·5 by the use of acetic acid and sodium acetate mixture. Otherwise, calcium does not remain in solution, but is precipitated with aluminium. Older textbooks had often stated that the precipitation of the calcium does not take place if the pH were just less than 6·0, but this is definitely wrong. It is true for calcium phosphate when alone, but not for a mixture of aluminium phosphate and calcium phosphate. Earlier in 1932, workers on the removal of aluminium by foodstuffs at the Mellon Institute of Industrial Research [5] had independently found it necessary to keep the pH of the solution at 4·2 when precipitating aluminium as phosphate in the presence of calcium. Gwyer and Pullen made check experiments with solutions containing known amounts of aluminium and calcium in which the calcium content was made equivalent to that in normal milk. They found that at a pH of 4·9 they obtained a precipitate which if calculated as aluminium—as would have been done if an unmodified Carnot method had been used—would work out at 120 grains per gallon of aluminium. But on altering the pH of the same solution to 4·5, by adding 5 cubic centimetres of acetic acid, the weight of the precipitate was reduced to 1/50, this latter weight being the exact weight of aluminium phosphate containing the known amount of aluminium previously put into the solution. From the filtrate was recovered all the calcium that had been previously put in. From these results we see that it is possible to record as aluminium phosphate a precipitate of the mixed phosphates of calcium and aluminium, giving an apparent aluminium content fifty times its true value if the correct pH is neglected. In addition, if the pH happened to be nearer still to 6·0, the amount of calcium included in the precipitate would be much greater.

Gwyer and Pullen then used their strict method for estimating the amount of aluminium removed by milk. They employed two pans, one quite new, the other having had more than a year's use. They took fresh milk for their experiments.

Two hundred and fifty cubic centimetres (equivalent to a glass of milk) were brought to the boil and kept boiling for two minutes. The milk was ashed in a dish, and a neutral solution made of it was treated with the correct amount of acetic acid and sodium acetate to give a pH of 4·5. They found that a sample of fresh milk unboiled and used as a control, contained the same minute amount of aluminium as was found in the milk boiled in either the old or the new pan, namely 0·0002 gramme of aluminum phosphate or 0·04 milligramme of aluminium. It is clear that under the conditions of the experiment, which expose the aluminium to the action of boiling milk for a longer period than would obtain in practice, no solvent action is exerted by the milk. The small amount of aluminium (0·16 part per million) was that naturally occurring in milk, a matter which will be discussed below. Schwartze, Murphy and Cox [9] had used a more sensitive method, the estimation of the aluminium after careful precipitation as phosphate at a pH of 4·2, not by weighing the precipitate but by conversion to an aurine-tricarboxylic acid lake, and estimating colorimetrically. By this method they found that the amount of aluminium removed by pasteurization at 60° C. for thirty minutes to be 0·60 part per million, or on a 550 cubic centimetre amount (one pint very nearly) this would be 0·28 milligramme or ten millionths of an ounce It is clear that the amounts of aluminium dissolved by milk under stringent conditions are infinitesimal, less than 0·4 grain per gallon. Von Fellenberg boiled 250 cubic centimetres of milk for twenty minutes: clean pans took up 0·18 milligramme (0·7 part per million), pans previously used for heating milk took up 0·05 milligramme (0·2 part per million), confirming Quam's discovery of a protecting layer of milk-protein.

A decision regarding the safety or otherwise of the use of aluminium utensils for use with food depends directly on the correct *quantitative* estimation of aluminium, and the method of choice when a determination of small amounts of aluminium in organic matter is required is certainly the latest form of the aurine-tricarboxylic acid lake process just indicated, and we shall now describe the work published since the issue of Dr. Burn's pamphlet. Emphasis should be laid at this point on the extreme sensitivity and reliability of the process since the results of Dr. Easte's analyses are entirely negatived by all the work just quoted, and by that about to be discussed.

As a qualitative test it was first introduced by Hammett and Sottery[10] in 1925. The quantitative application of the method has been worked over and improved since 1928 by various investigators including Myers, Mull and Morrison, Winter, Thrun and Bird, Schwartze, Murphy, Cox and Hann. In the latest extensive series of investigations on food contamination by aluminium, a meticulously careful technique was employed by Cox, Schwartze, Hann, Unangst and Neal [5] in collaboration. In outline, the method is to ash the food at a low heat in the dry way. Silica present is dehydrated in the usual manner by repeated evaporations with hydrochloric

acid, and is separated by centrifuging. The essence of the method is that in order to ensure obtaining all the aluminium in the minute quantities likely to be present, iron must be present in relatively large amounts, and be precipitated as phosphate with the aluminium, the latter being entangled in it. The phosphate precipitate is concentrated by centrifuging and removed, and in this way the whole of the aluminium is obtained in a small bulk of matter. The pH of precipitation is carefully regulated at 4·2 by the use of sodium acetate, three times molar strength. The aluminium is then to be converted to a lake with aurine-tricarboxylic acid (using the ammonium salt called aluminon), and estimated colorimetrically against standard acid-thymol-blue colour, calibrated for minute amounts of aluminum of the order of 0·015 milligrammes. The point to be noted in this method is that the iron while essential in the precipitation stage, must be *completely* removed before steps are taken to make the lake. In order to do so, the iron is precipitated as hydroxide, and sedimented by centrifuging ; and the last traces of iron in the supernatant aluminium-containing liquid are removed by filtering through two layers of filter-paper. The filtrate is then tested for iron by the very delicate mercapto-acetic acid test as devised by Lyons. The presence of iron in the lake would vitiate the results, as both ferrous and ferric salts form stable lakes with aluminium at pH 7·0. In 1929 Thrun had worked on the physical chemistry of lake formation, and his results as well as those of other workers mentioned above were of great value in perfecting the technique. The lake is prepared at a pH between 4·5 and 5·5, and after formation of the lake, sufficient ammonium carbonate is added to bring the pH to 7·1. The lake-former is a combined reagent, being a mixture of aluminon with ammonium carbonate and ammonium chloride, an improvement on previous methods. The investigators were very careful to maintain a rigid technique, even in the shaking of the solution during lake formation. The standard is not an aluminium standard lake previously prepared, as used by Winter, Thrun and Bird, since lakes prepared directly from aluminium are not so stable as the acid-thymol-blue. The standard actually employed is a pink solution which remains stable for over six months, and is prepared by taking 5 cubic centimetres of 0·04 per cent thymol-blue and 8 cubic centimetres of hydrochloric acid, six times molar strength, and making up to half a litre. It is standardised by taking known varied amounts of aluminium, subjecting them to the same process already described, and comparing the lake colour at thirty millimetres depth in a Duboscq colorimeter. The thymol-blue solution is the one which has to be altered in depth, the aluminium lakes being kept at thirty millimetres. From this series of figures a curve is plotted, and from this curve we can determine the amount of aluminium in a thirty millimetre aliquot of lake solution prepared from a material of unknown aluminium content. Differences of from 0·0005 to 0·005 milligramme can be measured. The investigators checked the probable error on sixteen samples taken at random, and found it to be $\pm$ 0·10 millimetre. Whereas where lake is com-

pared against lake, the error is two and a half times as great. In addition, the investigators employed the dry-ash method in preference to the use of sulphuric acid and an oxidizing agent, as it avoided the introduction of aluminium from outside, as well as the production of insoluble residues difficult to handle. They found by experiment that there was no loss of aluminium on ignition when the dry-ash method was used.

Enough has been said to indicate the care taken to obtain accurate results. To check the reliability of the method itself in a practical way, the investigators (*a*) took a sample of some food and determined the aluminium apparently present in it (the *absolute* figure, of course, is impossible to check). They then (*b*) added a definite amount of aluminium to the same weight of food, and again (*c*) measured the amount of aluminium now present. If the method is reliable, then (*c*) should equal (*a*) + (*b*).

For example, ground beef liver showed a natural aluminium content of 5 parts per million. They took 25 grammes of liver, equivalent to a content 0·125 milligramme of aluminium, and added 0·05 milligramme of aluminium, making an apparent aluminium content of 0·175 milligramme before ashing. The average recovery of aluminium on duplicate experiments was 0·1755 milligramme.

Having obtained a reliable method of aluminium estimation, the investigators (Beal, Unangst, Wigman and Cox) proceed to cook various foods (in duplicate) in both pyrex and in aluminium vessels, according to standard and accepted cookery-book receipts. It had been shown in 1928 by Myers, Mull and Morrison [11] that pyrex and silica vessels did not yield any aluminium to materials heated in them.

Any aluminium obtained by heating the food in pyrex vessels would therefore represent the natural aluminium content of the food. The figure obtained by heating the food in aluminium vessels would represent the sum of the natural content and of the aluminium removed by the action of the food.

The results of these investigations show that with neutral foods there is no appreciable removal of aluminium.

If cooked in bright pans, acid juices remove small amounts varying from 1 to 13 parts per million. If cooked in dark pans the amounts removed were somewhat increased, varying from 16 to 41 parts per million, with the exception of apricots, which were outstanding at 48·7 parts per million. The largest of these figures corresponds to a removal by fruit juices—if the diet were confined entirely to 2 kilogrammes of fruits per diem—of 82 milligrammes per diem. Naturally no one would subject himself to such a diet, but a removal of 82 milligrammes or three thousandths of an ounce, is well below the 200 milligrammes show to have on ill-effect on human beings over long periods.

The investigators also tried the effect of adding sodium bicarbonate to creamed cabbage, and the aluminum dissolved increased from 2·41 to 90·5 parts per million. Addition of sugar had the effect of reducing the action

of the food on aluminium. A random selection of the results is as follows :—

Food	Time of cooking	Aluminium, p.p.m. removed by food	Remarks
Beef pot, roast	2 hrs.	0·23	Using meat and proportional part of gravy.
Beef soup stock	2½ hrs.	0·23	
Boiled potatoes, whole	¼ hr.	0	
,, skins peeled	½ hr.	0·55	
Stewed tomatoes	20 mins.	4·16	Bright pan.
,,	,,	15·3	Dark pan.
Sauerkraut	45 mins.	15·6	
Creamed onions	¼ hr.	0·61	
,, cabbage	45 mins.	2·42	Without $NaHCO_3$.
,, ,,	,,	90·5	Cooked with bicarbonate.
,, cauliflower	20 mins.	1·47	
Cranberry sauce	10 mins.	7·36	Bright pan.
,, ,,	,,	27·5	Dark pan,
Rhubarb	5 mins.	12·5	Bright pan.
,,	,,	40·9	Dark pan.
Apricots	40 mins.	48·7	
Prunes	,,	2·50	
Apple Sauce	10 mins.	1·12	
Orange marmalade	90 mins.	2·76	

To apply a test more stringent than would obtain in practice, the investigators prepared apple butter over a period of six and a half hours (including the time taken to concentrate the cider). The effect of heating these acid juices for this long period was to remove 113 parts per million, an amount which is quite harmless.

A point which might be raised, taking into consideration the widespread nature of aluminium compounds, is whether the reagents used would introduce aluminium during the process of ashing, precipitating and lake-forming. The investigators checked this source of error by making up very large bulks of stock reagents from as pure materials as possible. In standardising the thymol-blue solution, the first match with solutions of known aluminium content against the thymol-blue solution gives the match for the aluminium put in plus the aluminium in the reagent. Control experiments were then made with the reagents, and the quantities of standard required were noted, and subtracted from the first readings. In this way, the colorimetric curve gives the net readings of true aluminium content. Each time an experiment was done on a material of unknown aluminium content, controls were made with all the reagents, and the net figures were obtained. The latter on reference to the curve of net standard readings will give the correct amount of aluminium. By using a *permanent* standard compared once and for all with definite amounts of aluminium, these workers were able to obviate introducing aluminium from the reagents, which is unavoidable when using the method of taking a series of aluminium lake standards, as some workers have done.

More recently Lampitt and Sylvester [12], having perfected the technique of their process over a period of six years, have employed a method derived from Hammett and Sottery similar to that used by the Mellon Institute investigators. Their slight modification consists in using the red

Lovibond tintometer unit readings plotted against known amounts of aluminium instead of a constant standard in the Duboscq colorimeter. Major Stanley Elliott, at the Royal Army Military College [13], has also analysed foodstuffs by the Hammett Sottery method, and obtained similar results.

Comparing the gross amounts of aluminium removed from foods found by investigators using the aurine-tricarboxylic-acid lake method with one another, and with the results given by other workers such as Massach and Fellenberg, we find all the investigators closely agreeing, and in all cases proving that only harmless and minute amounts of aluminium are removed from the utensils by the food.

Massach used a careful gravimetric method.

The different investigators used different times of heating and so on, but the following comparative figures are striking:—

Food	Aluminium removed from utensils (gross amount) p.p.m.	Investigator
Ham	2·1	Mellon Institute.
Bacon	1·28	Massach.
Boiled meat, broth	1·8 (2 hrs.)	von Fellenberg.
meat	7·5 (2 hrs.)	,,
Beef soup stock	0·39 (2½ hrs.)	Mellon Institute.
Bouillon of beef	2·86	Massach.
Sauerkraut	16·4 (¾ hr.)	Mellon Institute.
,,	14·0 (3 hrs.)	von Fellenberg.
Apple sauce	1·4 (10 mins.)	Mellon Institute.
,,	26·4 (no time given)	Massach.
Boiled apples	14·0 (½ hr.)	Lampitt and Sylvester.
,,	1·7 (½ hr.)	von Fellenberg.
	4·5 (stand 15 hrs.)	,,
Milk	0·67 (pasteurised ½ hour)	Mellon Institute.
,,	0·7 (20 mins. boiled)	von Fellenberg.
,,	0·8 (2 mins.)	Gwyer and Pullen.
,,	0·6 (½ min.)	Lampitt and Sylvester.
Tomato soup	4·18 bright pan (20 mins.)	Mellon Institute.
,,	15·5 dull pan (20 mins.)	,, ,,
,,	10·0 (½ hr.)	Lampitt and Sylvester.
Potatoes, peeled	1·1 (½ hr.)	Mellon Institute.
,,	6·0 (½ hr.)	Lampitt and Sylvester.
Cabbage, cooked with bicarbonate	90·8	Mellon Institute.
,,	9·5 (½ hr.)	Lampitt and Sylvester.

Taking a representative diet from the many foods analysed, the following estimations of daily aluminium intake (the sum of that normally supplied by the foodstuffs and that removed by the corroding action of the food) have been made by some workers.

Workers	Daily intake of aluminium in mg.	Parts per million on a 2 kg. total diet	Contributed by food in mg.
Mellon Institute (Cox, etc.)	12	6	5
Massach	7	3·5	?
Fellenberg	16	8	7

These results are very close and of the same order. The aluminon method having been investigated thoroughly since 1925 and used by many workers is now considered the most satisfactory method.

(*To be continued.*)

REPORT ON AN INVESTIGATION OF ENERGY EXPENDED ON THE EXERCISES OF THE PHYSICAL TRAINING TABLES FOR RECRUITS OF ALL ARMS.

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(*Continued from p.* 17.)

(VI) *Abdominal Exercises.*

In these exercises progression is mainly obtained in two ways, firstly by increasing the pull on either the upper or lower attachments of the muscles in varying positions by raising the arms above the head or by straightening the legs, and, secondly, by tending to remove support from these attachments, so that the strain of fixing either the chest or pelvis comes on the abdominal muscles.

They are subdivided into the following homogeneous divisions.

Table XXXVI.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. On the top bar. (Wall bars.) (Plate 39, fig. 90) ..	1	—	126
2. On the top bar.—Knees raise. (Plate 39, fig. 91) ..	3	—	175
3. Overgrip.—Knees raise. (Beam.) (Plate 39, fig. 92) ..	5	—	150
4. On the top bar.—Legs raising. (Plate 39, fig. 91) ..	6	—	218

Remarks.—In the case of the exercises on the "top bar" progression is obtained by increasing the pull on the pelvis by raising the knees and legs. In No. 3 progression is obtained by removing the support to the pelvis of the wall bar, leaving the fixing of it to purely muscular action. This exercise should show a higher expenditure in energy than the knee raising exercise on the wall bars.

Table XXXVII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. On the Hands on ground. (Plate 37, figs. 83 and 84) ..	2	—	146
2. On the Hands on ground.—Arms bend. (Do. and Plate 37, fig. 85)	3	—	215
3. On the Hands on ground.—Foot placing forward ..	5	—	251
4. On the Hands on ground.—Feet placing forward. (Plate 40, fig. 94)	5	—	302

Remarks.—Progression in these exercises is effected by the removal of support from the pelvis.

Table XXXVIII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Back against the wall bars, str. bright grasp.—Left (right) Knee raising, stretching and lowering. (Plate 39, fig. 90)	1	—	179
2. On the top bar.—Left (right) Knee raising, stretching and lowering. (Do.)	2	—	218

Remarks.—Progression is here obtained by the lessened support to the pelvis in the second exercise.

TABLE XXXIX.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Lying on the Back, Arms sidew.str.—Body raising and forward reaching. (Arms assisting)	1	—	218
2. Lying on the Back. A.upw.str., K.r. Feet on floor.—Legs stretching and Body raising to forward reach. (Plate 40, fig. 94)	2	—	233
3. Lying on the Back, A.upw.str.—Body raising to forward reach and Trunk stretching upward with Arms raising sideways. (Alternately)	3	—	232
4. Lying on the Back, A.upw.str.—Trunk raising and floor beat. (Plate 41, fig. 97)	4	—	240
5. Lying on the Back.—Trunk raising to forward reach and stretching upward with Hands placing backward. (Alternately.) (Plate 40, fig. 96)	5	—	244
6. Lying on the Back.—Body raising to forward reach and Legs raising. (Alternately.) (Plate 41, fig. 97 and fig. 98)	6	—	200

Remarks.—The last exercise would appear to be easier than any of the three preceding ones, and it is suggested that it might be further investigated with a view to putting it in one of the earlier tables—possibly III.

TABLE XL.

Exercise	Table	Cadence	Cals. per sq. metre per hour
F.astr.N.r. Tr.forw.b.—Trunk bending downward	1	—	252

Remarks.—This exercise is partly dorsal as well as abdominal.

(VII) *Dorsal Exercises.*

These exercises bring into play and develop the whole of the extensors of the spine from the sacrum and pelvis to the skull.

They are subdivided into the following homogeneous groups :—

TABLE XLI.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. F.astr.H.f.—Trunk bending backward	1	—	70
2. F.astr.H.f.—Trunk bending forward. (Plate 42, fig. 100)	1	—	81
3. F.astr.A.upw.str.—Trunk bending forward. (Plate 43, fig. 104)	6	—	139

Remarks.—Progression is obtained by throwing the weight higher by means of the arms.

TABLE XLII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
Kneeling, sitting on Heels, Hands clasped behind back, Forehead on Knees.—Back stretching. (Plate 47, fig. 117) ..	2	—	159

Remarks.—This exercise cannot be grouped with any other.

TABLE XLIII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
Trunk bending downward and up to Arms bend position. (Quickly.) (Plate 48, fig. 120)	3	—	273

Remarks.—This exercise cannot be included in any of the other groups.

TABLE XLIV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Tr.forw.b.—Arms swinging backward, forward and upward. (Plate 42, fig. 102)	4	—	263
2. F.sidew.pl.A.forw.b.,Tr.forw.b.—Arms flinging. (Plate 47, p. 116)	5	—	195

Remarks.—The expenditure for both of these exercises appears too low. It is thought that the first is the more strenuous and that a change in their respective order in the tables might be considered.

TABLE XLV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Forw. lying.—Hips firm. (Plate 45, fig. 109)	4	—	168
2. Forw. lying, H.f.—Trunk bending forward and backward. (Plates 45 and 46, figs. 111 and 112)	5	—	158
3. Forw. lying, A.b.—Trunk bending forward and backward, Arms stretching sideways	6	—	181

Remarks.—In these exercises the strain is very localized, and although they are strenuous, the calories expended are not great. The second of the group cannot have been properly performed, as there can be no doubt about its progression from the first. The low output in calories for these exercises helps to lower the average for dorsal group in Tables IV, V and VI. There is a considerable static element in these exercises which, although not costly in calories, exerts a severe strain on the system.

TABLE XLVI.

Exercise	Table	Cadence	Cals. per sq. metre per hour
Lying Face downwards, A.sidew.str.—Trunk raising. (On ground.) (Plate 48, fig. 118)..	5	—	126

Remarks.—Another strenuous exercise—localized in its action—which tends to lower the average of the dorsal group in Table V. 126 cals. per square metre per hour and is out of all proportion to the difficulty of the exercise. The static element also enters largely into this exercise in keeping the body rigid.

TABLE XLVII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
Sit. pos. L. straight, Feet grasp.—Trunk bending downward (Plate 48, fig. 119)	4 and 6	—	199

Remarks.—A very strong stretching exercise.

(VIII) *Final Exercises.*

In these exercises there are easy simple movements to enable the circulation and respiration to return slowly to normal and also to allow the body to cool gradually.

No attention need be paid to progression in these groups.

The exercises have been grouped together as under :—

TABLE XLVIII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Arms bending and stretching (slowly). (Various directions)	1	—	116
2. Arms bending and stretching with Fist clenched (slowly). (Various directions)	6	—	105

Remarks.—Slow easy exercises, which are rightly put in final groups.

TABLE XLIX.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Heels raise. (Plate 5, fig. 11)	1	—	85
2. H.f.—Heels raising and Knees bending (Plate 5, fig. 12) ..	2	—	167
3. H.f.—Heels raising and Knees full bending	4	—	193

Remarks.—It is considered that "Heels raising and knees full bending," is rather too strenuous an exercise for this group. Its effect is very localized, being chiefly felt by the "quadriceps extensor" muscle. It is suggested that it would be more suitable for the Introductory group.

TABLE L.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. With Fingers stretching Head bending backward (Plate 8, fig. 19)	1	—	69
2. With Fingers stretching Head bending from side to side (Plate 8, fig. 21)	2	—	63
3. With Fingers stretching Head turning from side to side (Plate 32, fig. 75)	3	—	78
4. Head bending forward and backward	5	—	64
5. With Fingers stretching.—Head rolling. (Plate 8, fig. 23)	6	—	65

Remarks.—The exercises, whilst primarily intended for the development of the neck muscles, are correctly placed in this group, as they are quiet easy movements with low calorie expenditure.

TABLE LI.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. Arms swinging upward. (Plate 9, fig. 36)	1	—	128
2. A.forw.r.—Arms parting	3	—	128
3. A.sidew.str.—Arms swinging forward and upward ..	4	—	149
4. A.forw.b.—Arms flinging	5	—	145

Remarks.—Easy exercises which tend to increase the mobility of the chest and help respiration as well as exercising the arm and shoulder girdle muscles.

TABLE LII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
Marching with Toe leading	1	120	214

Remarks.—Suitable as a final exercise.

TABLE LIII.

Exercise	Table	Cadence	Cals. per sq. metre per hour
H.f.—Foot placing sideways. (Plate 5, fig. 13)	3	—	99

Remarks.—Suitable as a final exercise.

TABLE LIV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. F.full o.H.f.—Lunging forward. (Plate 6, fig. 16) ..	5	—	187
2. F.full o.A.forw.b.—Outward lunging. (Plate 32, fig. 75)	6	—	188
3. F.full o.A.forw.b.—Outward lunging with arms flinging. (Do.)	6	—	203

Remarks.—Suitable as a final exercise.

(IX) *Corrective Exercises.*

There are only two exercises in this group and they are common to all the tables. The first and chief one is deep breathing, which is introduced at this stage to help to ventilate the chest and bring the respiratory and circulatory systems back to normal. The tables are completed by the "position of attention."

It is considered that the Corrective group could with advantage be absorbed into the Final, as the term corrective implies that the need exists for some effort of correction—in other words, that some exercise or exercises have been performed which have resulted in an unbalanced effect. This should not have occurred if the tables had been properly taken.

TABLE LV.

Exercise	Table	Cadence	Cals. per sq. metre per hour
1. F.astr.H.f.—Deep breathing	All tables	—	82
2. Position of attention	All tables	—	53

Remarks.—The breathing above was mainly "thoracic" in character, as experiments were carried out on purely "abdominal" deep breathing, and the results of four experiments gave a mean expenditure value of 61 cals.

B.—CLASSIFICATION OF EXERCISES FROM TABLES 1 TO 6 IN THE MANUAL OF PHYSICAL TRAINING INTO SEQUENCE GROUPS.

The progression of each group in the different tables can be observed. Agility exercises have been omitted.

Each group will be discussed with regard to the progression of the mean energy expenditure as shown from table to table.

TABLE LVI.

(I) MARCHING AND RUNNING EXERCISES.

Table	Calories	Exercise
1.	192	Quick march.
	450	Double march.
	235	Double march—Heels.
	256	Mark time with opposite Knee and arm raising.
Mean ..	283	
2.	283	As before.
	172	H.f.—With Knee raising mark time.
	450	Double march.
	252	Marching with opposite Knee and Arm raising.
Mean ..	289	
3.	289	As before.
	333	Rapid march.
	457	H.f.—On alternate Feet hop.
	219	H.f.—In quick time sideways march.
Mean ..	324	
4.	324	As before.
	182	H.f.—With Knee raising march.
	383	H.f.—With Knee raising double mark time.
	382	Running on the spot.
Mean ..	318	
5.	318	As before.
	484	H.f.—In double time sideways march.
	517	On alternate Feet hop with Arms raising sideways.
	132	Slow march.
Mean ..	363	
6.	363	As before.
	558	On alternate Feet hop with Arms swinging upward.
	447	Hopping with opposite Knee and Arm raising.
Mean ..	473	

The one table which does not show progression in this group is 4, but the remarks made under Table IV of this report explain that one of the exercises in the table (and there are only four altogether) shows a much lower expenditure value than it should do.

TABLE LVII.

(II) INTRODUCTORY EXERCISES.

Table	Calories	Exercise
1.	283	F.astr. One Hand H.f.—Arms circling.
	400	H.f.—Astride jumping.
	179	F.astr.A.l.c.—Arms fling from low cross to sideways stretch.
	366	H.f.—Hop with Toe placing sideways.
Mean ..	307	
2.	397	Astride jumping with Arms raising sideways.
	281	F.astr.Tr.forw.b.—Arms swinging backward, forward and upward.
	286	F.astr.H.f.—Trunk bending downwards. (Quickly.)
	343	H.f.—Hop with Toe placing forward.
	417	Small jumps with single Arm stretching.
	147	Small and large Arm swings.
Mean ..	317	
3.	252	A.l.c.—Heels raising with Arms flinging to flight.
	357	H.f.—Hop with Toe placing sideways and forward.
	497	Jumping with alternate Arm stretching.
	273	F.astr.—Trunk twisting with alternate Arm flinging.
	324	Heels raising and Knees bending with Arms forward raising, forward bending, flinging and lowering.
Mean ..	339	
4.	135	Small Arms swing with Feet placing sideways.
	312	A.l.c.—Heels raising and Knees bending with Arms flinging to flight.
	260	F.astr.Tr.forw.b.—Floor beat with Knees straight.
	292	Hopping with Leg raising sideways.
Mean ..	250	
5.	418	Astride jumping with Hands clap above head.
	329	Heels raising and Knees bending with small and large Arm swings.
	289	F.astr.Tr.forw.b.—Floor beat with Arms swinging backward, forward and upward.
	307	High kicking at Hand.
Mean ..	336	
6.	355	Hopping with Leg raising sideways and opposite Arm raising to flight.
	456	Small jump with Arms stretching.
	318	F.astr.—Floor beat and Trunk stretching forward with Neck rest.
	432	H.f.K.full b.—Jumping forward sideways and backward.
Mean ..	390	

Tables 4 and 5 do not show progression in the mean values. The expenditure values shown for the majority of the exercises in Table 4 are too low—see remarks under Tables IX, X, XI and XII. In the remarks under Table IX it is suggested that one of the exercises in this group should be transferred.

The mean value of Table 5 is probably about right. Table 3 is a little high.

TABLE LVIII.

(III) HEAVING EXERCISES.

Table	Calories	Exercise
1.	160	Arms stretching forward, sideways, upward and downward.
	119	Arch hanging.
Mean ..	139	
2.	199	Arch hanging.—Arms bend.
	131	Fall hang.
	326	Climbing.
Mean ..	219	
3.	210	Fall hang.—Arms bend.
	326	Climbing.
	141	Overgrip
	282	Overgrip.—Arms bend.
	172	Crossgrip.
	242	Crossgrip.—Arms bend.
Mean ..	229	
4.	161	Oblique grip.
	297	Oblique grip.—Arms bend.
	195	Undergrip.
	285	Undergrip.—Arms bend.
	305	Climbing down (Hand under Hand without use of Feet).
Mean ..	249	
5.	305	Climbing (down Hand under Hand without use of Feet).
	242	Crossgrip.—Arms bend.
	262	Undergrip.—Upward circling (beam Head Height).
	245	Overgrip.—Side travelling changing grip.
Mean ..	263	
6.	305	Climbing (down Hand under Hand without use of Feet).
	281	Undergrip.—Upward circling (beam stretch height).
	329	Mounting shelf (with assistance).
	232	Overgrip.—Side travelling with swing.
Mean ..	287	

The mean values in the Heaving exercises in each table show good gradation in progression right throughout.

TABLE LIX.

(IV) LATERAL EXERCISES.

Table	Calories	Exercise
1.	215	F.astr. One A.b., One Hand H.f.—Trunk bending.
	183	F.astr. H.f.—Trunk bending from side to side.
Mean ..	199	
2.	134	F.cl., One A.b., One Hand H.f.—Trunk bending sideways, with Arm stretching upward.
	209	S.position.—Trunk bending sideways (quickly).
Mean ..	171	
3.	184	On the Hands on ground.—On the Left (Right) Hand turn, Leg raising.
	206	Ditto.—At wall bars.
	170	On Ks., l.(r.) L.sidew.str., Hs. on H.—Trunk bending sideways.
Mean ..	187	
4.	215	H.f., F.support.—Trunk bending sideways.
	219	Trunk bending from side to side (quickly).
	170	On Ks., l.(r.) L.sidew.str., Hs. on Hd.—Trunk bending sideways.
Mean ..	201	
5.	204	One A.upw.str., One Hand H.f., F. support.—Trunk bending sideways.
	207	Sit.pos.—Trunk twisting with single Arm flinging.
Mean ..	206	
6.	125	H. support, one A. upw. str. One Hand H.f.—Trunk bending sideways. (Beam.)
	251	On the Hands on ground.—On the Left (Right) Hand turn, Leg raising.
	240	On Hands and Knees.—Trunk twisting with single Arm flinging.
Mean ..	205	

Tables 2 and 3 do not show progression in the mean expenditure values, but the remarks underneath Table XXXI explain that progression does occur even though the caloric expenditure is low.

TABLE LX.

(V) BALANCING EXERCISES.

Table	Calories	Exercise
1.	90	H.f.—Knees raise.
	100	H.f.—Leg raising sideways.
Mean ..	95	
2.	102	H.f.—Leg raising sideways and backward.
	106	Walking backward and forward on benches (laid side by side).
Mean ..	104	
3.	120	H.f., K.r.—Leg stretching forward and backward.
	115	H.f.—Leg raising forward, sideways and backward.
	186	Mounting beam. (Knee height.)
	182	Mounting beam. (Knee height.) Turning about.
Mean ..	151	
4.	127	H.f., K.r.—Leg stretching forward, sideways and backward.
	208	Mount with foot assisting, walking forward and downward jumping (beam waist high).
Mean ..	167	
5.	126	Leg raising with Arm raising upward.
	174	Mount with foot assisting, walking forward and backward (beam waist height).
Mean ..	150	
6.	123	Leg raising forward, sideways and backward with Arms raising forward, sideways and upward.
	158	A.b., K.r.—Leg and Arm stretching (various directions).
	236	Mount with foot assisting, walking forward (beam shoulder height).
Mean ..	172	

In these exercises the energy expenditure need be no criterion of the progression, but nevertheless Table 5 is the only one in which progression is not shown in the mean value.

TABLE LXI.

(VI) ABDOMINAL EXERCISES.

Table	Calories	Exercise
	218	Lying on the Back. Arms sidew.str.—Body raising and forward reaching. (Arms assisting.)
1.	252	F.astr. N.r. Tr.forw.b.—Trunk bending downward.
	126	On the top bar. (Wall bars.)
	179	Back against the wall bars, str. height grasp.—Left (Right) Knee raising, stretching and lowering.
Mean ..	194	
	218	On the top bar.—Left (Right) Knee raising, stretching and lowering.
2.	146	On the Hands on ground.
	233	Lying on the Back, A.upw.str.,K.r.,Feet on floor.—Legs stretching and Body raising to forward reach.
Mean ..	199	
	218	On the Hands on ground, Arms bend.
3.	175	Lying on the Back. A.upw.str.—Body raising to Forward reach and Trunk stretching upward with Arms raising sideways. (Alternately.)
	232	On the top bar.—Knees raise.
Mean ..	208	
	218	On the Hands on ground, Arms bend.
4.	175	On the top bar.—Knees raise.
	240	Lying on the Back, A.upw.str.—Trunk raising and floor beat.
Mean ..	216	
	251	On the Hands on ground, Foot placing forward.
5.	303	On the Hands on ground, Feet placing forward.
	150	Overgr.—Knees raise (Beam).
	244	Lying on the Back.—Trunk raising to forward reach and stretching upward with Hands placing backward. (Alternately.)
Mean ..	237	
6.	218	On the top bar.—Legs raising.
	200	Lying on the Back.—Body raising to forward reach and Leg raising. (Alternately.)
Mean ..	209	

Progression in calorie expenditure is shown throughout in the mean values of these groups with the exception of Table 6. Attention is directed to the remarks under Table XXXIX with regard to the exercise "Lying on the Back.—Body raising to forward reach and Leg raising. (Alternately.)"

(To be continued.)

Editorial.

CHRONIC ENTERIC CARRIERS.

. The Medical Research Council has just published a very interesting report on chronic enteric carriers and their treatment by Professor C. A. Browning, F.R.S. The work was instituted at the request of the Scottish Board of Health and was carried out in Glasgow. Dr. H. L. Coulthard, Dr. R. Cruickshank, Mr. K. J. Guthrie and Mr. P. R. Smith co-operated at times, and received personal grants from the Council, who also provided the expenses of the inquiry.

The Report is not confined to the author's researches. The opportunity is taken of reviewing the whole subject. The most recent information on the subject of typhoid carriers is given, and we think a brief résumé of the most important points may be of interest to officers of the Corps.

For convenience carriers are classified according to the period of time during which they excrete the specific bacilli, and according to the site of proliferation of the organisms.

It is recognized that a temporary carrier state may follow an acute attack of typhoid fever, and that it is difficult to assign a definite limit for the duration of the excretion of specific organisms. A large proportion of these cases cease to excrete the bacilli within six months of convalescence and this appears to be particularly true of the excretion of *Bacillus paratyphosus* A or B. According to Burke the temporary excretion of the specific organisms is a marked feature of convalescence from paratyphoid B infections. Garbat found that 32 per cent of his patients continued to harbour typhoid bacilli for varying periods after the temperature was normal, but only two of these convalescents continued to excrete *B. typhosus* for twelve weeks or longer.

The high incidence of these temporary carriers suggests the necessity of maintaining precautions against the spread of infection during the convalescent period as well as during the acute phase. It is also important to remember that the excretion of the specific bacilli in the fæces, and especially in the urine, may set in several months after convalescence.

It is generally agreed that those who continue to excrete the bacilli after a year will not become cured spontaneously and are to be regarded as *permanent* (*chronic*) carriers. The proportion of convalescents who become chronic carriers has been variously estimated. Leishman, from an anaylsis of convalescent soldiers at Addington Park, found that 2·93 per cent. continued to excrete typhoid bacilli for more them than six months after the fever had subsided. He thought that possibly the figures exaggerated

the true percentage of chronic carriers as many mild cases of enteric fever in the distant theatres of war were not invalided to England. It is, however, generally regarded as probable that 2 to 5 per cent. of all cases of typhoid fever become permanent carriers, but where the disease is mild and infrequent, as in England at present, the rate is probably lower.

Chronic carriers may be fæcal or urinary excretors. The fæcal excretor may be a biliary carrier—harbouring the germs either in the gall-bladder or in the liver or bile-ducts, or in both situations—or a true intestinal carrier in whom the bile is not infected, the organisms persisting in the intestinal tract.

The diagnosis of a true intestinal carrier rests on the finding of persistently positive cultures from the fæces or intestinal contents and negative results from the bile. It is not known whether in such intestinal carriers the specific organism may simply persist as a member of the intestinal flora, or whether the tissues of the bowel are actually invaded. The appendix has been regarded by a number of observers as a breeding-ground of the organism. Chronic fæcal carriers are usually married women, aged 34 and upwards. Statistics show that there are four or five female chronic carriers to one male.

In the case of biliary carriers it is important to know whether the specific bacilli persist and multiply exclusively in the gall-bladder or whether they may parasitize the bile-ducts and liver tissue. Animal experiments have shown that after the injection of a considerable dose of typhoid bacilli the organisms are excreted by the liver and may soon appear in the bile or the hepatic duct. These infections tend to disappear spontaneously. Bacilli may appear in the gall-bladder when the cystic duct is ligatured so it is thought that the chronic carrier state may be due to the emboli of typhoid bacilli in the capillaries of the mucous membrane. Though experimental evidence seems to indicate that the chronic carrier state is due to a definite lesion of the wall of the gall-bladder, there is often very little histological evidence of anything abnormal in its walls; and, therefore, the state cannot always be attributed to an acute infection. Bacilli may persist in the ducts when the gall-bladder is congenitally absent; also portions of the liver removed from chronic carriers during operation on the gall-bladder may yield growths of *B. typhosus*.

Most observers are agreed that a condition of chronic cholecystitis has been found in a large proportion of enteric carriers who have been operated on. The association of gall-stones with the carrier condition is also well established.

Gall-stones were found in only one of the three cases operated on in the series observed by Professor Browning and although the gall-bladder contained both *B. typhosus* and coliform bacilli, only slight thickening of the mucous membrane was detected with the naked eye. Similarly, no naked-eye changes were evident in the gall-bladder of the paratyphoid B carrier, which contained the specific organisms and also coliform bacilli. The

gall-bladder of the third case which contained *B. typhosus* in pure culture, showed thickening of the wall and towards the neck was adherent to the liver. On microscopic examination of the mucosa the lining epithelium may show little evidence of catarrh. The most marked change found in all the gall-bladders was a localized and diffuse collection of cells in the mucosa, which were plasma cells and leucocytes with scanty eosinophiles. Garbat considered that the carrier state is maintained by the gall-bladder "acting as a test-tube containing the bile medium in which the typhoid bacteria propagate without affecting the gall-bladder itself."

Urinary carriers of typhoid bacilli are often found in the latter part of the pyrexial stage of the disease or early in convalescence. The bacilli may appear suddenly in enormous numbers. Garbat found 49 per cent. of typhoid convalescents were excreting the *B. typhosus* in the urine, but at the end of the third month of convalescence the bacillus had disappeared in all of them. Striking features are the late period of convalescence at which the bacilli may appear, and also the intermittency of the excretion. Only a small proportion of the subjects become chronic carriers, and these, unlike the biliary carriers, are not preponderatingly of one sex.

It has been suggested that during enteric fever the urine becomes infected from a bacteriæmia by a process of filtration through intact kidneys, but unfortunately for this hypothesis the infection of the blood is at its height in the early stages of the disease, while the bacilluria appears comparatively late. The view now commonly held is that the bacilluria is due to the rupture into the tubules of focal lesions. Where the bacilli persist in the urine, it is the rule to find some pathological condition in the urinary tract, and the nidus of infection appears to be situated in the kidney or kidney-pelvis. This has been clearly proved in the case of urinary carriers in whom the bacilli have been restricted to the urine from one ureter, and on the infected side some abnormality has been found. Whatever the nature of the original infection, the bacilli may persist for years and cause extensive damage of the kidneys. Pick, on the basis of post-mortem observations on enteric fever cases, has suggested that the typhoid or paratyphoid bacilli may multiply in the prostatic ampullæ and seminal vesicles in males or in the ducts of the urethral glands in females, and so keep up the infection of the urine.

The chances of the spread of infection from patients suffering from enteric fever have been greatly reduced by general hygienic measures. In large towns the cases are mainly sporadic in spite of the fact that organisms of the enteric group can often be recovered from the sewage of the towns. The cases are generally attributed to a chronic carrier, and this is especially the case where the hygienic measures are less perfect, as in rural areas. The chance of infection in rural areas seems to be increasing owing to the tendency of town-dwellers to make weekly excursions into the country.

An important fact is that a carrier may transmit infection only at intervals, which may be separated by non-infective periods of years. But it

seems unlikely from the investigations of Browning and others that the negative periods extend to more than six or twelve months.

Urinary carriers have greater opportunity of spreading infection than fæcal carriers and, in addition, they may void large numbers of typhoid bacilli in practically pure culture.

For the prevention of the carrier state, adequate care of the patient during the attack and convalescence is important on general grounds. Anti-typhoid inoculation, by reducing the number of acute cases, should lessen the incidence of the carrier state.

Bumke's figures for the German Army during the war support this view. But Simmons and McCarthy did not find vaccination highly effective in preventing the persistence of the organisms during convalescence. Also the general result of animal experiments showed that the injection of typhoid antigens failed to reduce materially the proportion of animals which became carriers after intravenous inoculation. But these results were obtained before the new work on the differences in the protection afforded by various races of the typhoid bacillus were known. It is not possible to say what would be the result of employing the potent strains now available.

For the control of the danger due to carriers Browning thinks that all authorities should have compulsory powers to obtain for examination blood, fæces, urine, etc., of all convalescents and persons suspected of being carriers. If a carrier is detected, there should be some control of his activities, and there should be legal restraint to his handling of foodstuffs ready for consumption. In Scotland, the Public Health Regulations, 1921, give local authorities power to remove to hospital or to isolate a carrier in such a way as to prevent danger to the community. A carrier has to be certified by a medical officer of health and a registered practitioner, and the certificate is in force for three months and can be renewed indefinitely for such periods. In England the regulations only give power to prevent a carrier being employed in the preparation of food or handling of food or drink for a specified period.

The control of carriers in mental hospitals is very difficult, and in Scotland all known carriers have recently been segregated in one institution.

For the isolation of the specific organisms, Browning emulsified specimens of fæces in glycerine-saline and used this emulsion to inoculate a plate of MacConkey's bile-salt lactose agar, and at the same time tubes of peptone water containing brilliant green in various concentrations which after twenty-four hours' incubation at 37° C. were subcultured on MacConkey's medium. The emulsion was also kept at room-temperature until the next day and was used to inoculate a further plate if the initial plate failed to show non-lactose fermenting colonies. *B. typhosus* was recovered more frequently by direct plating than by the brilliant green method. *B. paratyphosus* B was, however, frequently recovered in pure culture from the brilliant green, when there were only a few colonies on

the initial plate. Replating from the glycerine-saline emulsion often resulted in positive findings of both *B. typhosus* and *B. paratyphosus* B, which would otherwise have been missed.

It has been found that in enteric carriers positive cultures may be yielded by the bile obtained by means of the duodenal tube when examinations of the fæces have been negative. This procedure is to be regarded only as an alternative method as the duodenal contents like fæces may yield the bacilli intermittently, although Garbat regards this as unusual. Garbat recovered *B. typhosus* from the duodenal contents of 20 of 136 convalescent cases after three consecutive specimens of fæces at six days' intervals had been reported negative. He therefore considers that two consecutive negative bile cultures along with two consecutive negative examinations of the fæces should be adopted as the criterion of freedom of the intestinal tract from infection, no special interval between the examinations being required.

The isolation of enteric organisms from the urine and their constant absence from fæces is the only conclusive evidence of the urinary carrier. But Browning points out that the specific organisms may be excreted in the urine when the focus of infection is apparently confined to the intestines or gall-bladder.

In the case of failure to isolate the specific organism from the urine, bile or fæces, the Widal test, the complement-fixation reaction and the opsonic index have all been used for the detection of carriers.

The Widal test has a limited value as many enteric carriers do not give a positive reaction. According to Pijper, in a series of seven typhoid carriers examined by him in South Africa, the sera showed "O" agglutination exclusively; this would account for the absence of agglutination when tested by the ordinary methods. There is also the difficulty of co-agglutination between the enteric organisms. These according to Weil and Felix are due only exceptionally to large flaking agglutinins, and are caused by small flaking "O" group agglutinins.

McKendrick has suggested that the skin-sensitivity test may be of value in the diagnosis of the carrier condition when the Widal reaction affords little aid. The difficulty as regards the test is that no satisfactory method of standardizing the dosage and effectiveness of the bacterial emulsions is yet available.

The treatment of carriers by drugs or vaccines has proved ineffective. Attempts have failed to find substances which will be excreted in the bile and attain a bactericidal concentration in the gall-bladder without proving toxic to the host. Efforts to cure enteric excretors by changing the flora or reaction of the intestine have also had no effect.

Browning noticed the spontaneous appearance of *B. proteus* in the fæces and urine of two typhoid carriers after an operation had been performed; the *B. typhosus* then disappeared from the excreta. It is still undetermined whether the proteus was the cause of this elimination.

Treatment by the administration of a typhoid bacteriophage has been tried, but the results do not permit of any definite conclusions being drawn with regard to the relation of the bacteriophage to the excretion of the specific organisms by typhoid carriers.

Vaccine therapy has also failed to cure enteric carriers. In 1912 Ledingham and Arkwright stated that " the treatment of intestinal carriers by typhoid vaccines has, it must be confessed, been unsuccessful or indecisive." Browning considers this statement does not require modification in the light of more recent work. He found that treatment by vaccine *per os* according to Besredka's method or by vaccines subcutaneously had no effect on the excretion of *B. typhosus* in the fæces of carriers.

In view of the practically complete failure of non-operative methods to cure the carrier state, operations on the gall-bladder for fæcal carriers have been undertaken, and in some cases with success. Dehler, in 1907, was the first to undertake a deliberate operation on the gall-bladder and reported successful results. In order to be sure that a *chronic* carrier has been cured by removal or drainage of the gall-bladder the fæces must be examined for one or two years after this operation, as we know that periodic excretion of the specific bacilli is not uncommon in these cases. Garbat considered that two negative cultures from the duodenal contents and two consecutive negative cultures from the fæces, irrespective of the interval between them, offered an absolutely safe indication of the absence of typhoid bacteria from the intestinal tract. But Browning states that a long series of cultures cannot safely be omitted. He says that as regards the evidence of cure, details in the literature are often meagre and frequently it has been necessary to accept the writers' bare statements on the point. He gives a table of cases about whom satisfactory information was obtained; from this it appears that out of 38 proved fæcal excretors of *B. typhosus* 28 were cured by cholecystectomy, and of 19 carriers of *B. paratyphosus* B 15 were similarly cured. Two of Browning's cases were followed up for four or five years afterwards, and finally the duodenal contents were found free from specific organisms. Cholecystostomy was successful in seven out of ten cases operated on.

Cholecystgastrostomy—anastomosis of the gall-bladder to the pyloric end of the stomach—was first suggested for the cure of the carrier state by Mr. Farquhar Macrae and carried out by him on two cases investigated by Professor Browning. By the operation the gastric contents are diverted into the gall-bladder and human gastric juice appears to have the power of destroying the *B. typhosus* in a very short time. In one of Browning's cases a cure resulted, but in the other cure did not follow the operation probably owing to the orifice becoming too contracted.

It would be a great help in selecting the most suitable type of case for operation if it could be determined with certainty whether the biliary tract was the seat of infection and whether the gall-bladder was the sole site of infection. There does not seem to be any method of showing that the infection is restricted to the gall-bladder.

The treatment of chronic urinary carriers by drugs and vaccines is usually unsatisfactory ; frequently there are gross lesions in the urinary tract that account for the failure to effect a cure. In a few cases where ureteral catheterization has shown the infection to be unilateral removal of the infected kidney has been effective ; in other cases nephrotomy and removal of a calculus has brought about a cure.

It has to be borne in mind that chronic fæcal excretors may occasionally pass urine containing the specific bacilli without their being actually chronic urinary carriers. In any case urinary carriers must be observed for a sufficient time before declaring a cure, as the excretion of bacilli is known to be markedly intermittent.

Clinical and other Notes.

TWO CASES OF CYSTICERCOSIS (*TÆNIA SOLIUM*).

By Major H. B. F. DIXON, M.C.,
Royal Army Medical Corps.

Fusilier J., enlisted in 1924, at the age of 18. There was no history of fits before enlistment and no family history of fits; except for rheumatic fever at 8 years of age, he had had no illnesses before joining the Army. In 1926 he proceeded to India and served there six and a half years, mainly in the Central Provinces and in the Punjab. In 1927 he noticed a small nodule on his right forearm when boxing but did not report it.

His medical history sheet shows an entry for myalgia in 1928 with three days fever of a low type and with pains in his back. Three months later appears the first entry for a supposed fit which he had in barracks.

From 1928 to 1932, there are numerous entries on his sheet for fits, but there appears to have been some doubt in the minds of the medical officers who treated him as to the nature of these fits as the entries invariably state that they were not true epileptic fits, and in most cases they were diagnosed as being hysterical. There is one entry for heat stroke and several for myalgia. Finally, in 1932 he had a series of fits, Jacksonian in type, involving the left face, arm and leg, without loss of consciousness, the fits lasting about two minutes. These were followed a few days later with what are described as true epileptic fits with loss of consciousness. He was invalided from India at the end of 1932 as a case of epilepsy major.

On his arrival in the United Kingdom it was found on examination that there were numerous subcutaneous nodules scattered all over the body; he was still having fits.

He was transferred to the Queen Alexandra Military Hospital, Millbank. On arrival there he was suspicious, truculent, obstinate and difficult to deal with. There were subcutaneous nodules on the forearms, chest and especially on the back; nineteen in all.

One of the nodules on the chest wall was excised and a calcifying *Cysticercus cellulosæ* was found in it.

Complement fixation tests carried out by Dr. Hamilton Fairley were found to be strongly positive as were also the intradermal tests. There was no history of tapeworm.

Except for the subcutaneous nodules, his mental condition and epileptiform fits, there were no apparent physical signs of any organic disease in any system.

His blood showed a four per cent. eosinophilia; the fæces were negative for ova or segments of tapeworm. X-ray examination of the skull and

long bones showed no evidence of calcifying cysts. The cerebrospinal fluid was normal. Wassermann reaction of blood and cerebrospinal fluid was negative, but the Kahn test of the blood was strongly positive. There was no evidence or history of syphilis. His eyes were normal.

He was treated with bromides and luminal and ten intravenous injections of tartar emetic, starting with ½ grain and working up to 2½ grains per injection, given at intervals of three days.

The condition was unchanged when he was invalided from the Service as a case of cysticercosis (*Tænia solium*) with epilepsy.

Private R., enlisted in 1922, aged 18. He had no illnesses before enlistment and there was no history of fits.

He proceeded to India in 1923, and three years after his arrival there had his first fit. He had a succession of epileptiform fits from 1926 to 1929, and, as he stated, "much trouble with his stomach." There are several entries on his medical history sheet for atonic dyspepsia and gastric dilatation with vomiting. There is no history of tapeworm infection.

He served for five years in India mainly in the Punjab and the United Provinces and was finally invalided as suffering from epilepsy major, after seven years service and aged 25. On his return to civil life his fits continued. From the date he was invalided from the Army, December 13, 1929 to April 1, 1933, he had twelve fits. Early in the latter year he applied to the Chelsea Commissioners for reconsideration of his case and was admitted to the Queen Alexandra Military Hospital, Millbank, for investigation.

On admission he was found to be an intelligent, well-nourished man. Four subcutaneous nodules were discovered in the left and right forearm, the back and the right groin. The nodule in the groin was about the size of a pigeon's egg, the others the size of peas, and all were freely movable under the skin.

He stated that the lump in his groin had started in 1930; the others had not been noticed by him until his attention was drawn to them at Millbank. The large nodule was excised and was found to contain a larva of *Tænia solium*.

There were no apparent physical signs of organic disease in any system except the nodules reported above. The blood-count showed no eosinophilia. The complement fixation test carried out by Dr. Hamilton Fairley was negative in ordinary dilutions, but with 3 M.H.D. of complement it gave a weak positive group reaction to tapeworm antigen. Intradermal tests were negative. The cerebrospinal fluid was clear and not under pressure; it contained six lymphocytes per cubic millimetre, globulin and sugar were in normal quantities. Seven examinations of stools were negative for worm segments or ova. His eyes were normal. X-ray examination of the limbs showed two calcified cysts, one in the right forearm and one in the right upper arm.

He had one fit in hospital. He was treated with ten injections of intravenous tartar emetic, starting with ½ grain increasing every third day until a dose of 2½ grains was given; in all he received 19 grains. His condition was unchanged on discharge from hospital.

These two cases illustrate how necessary it is to view with suspicion all alleged idiopathic epilepsy occurring in soldiers, aged 24 to 26, who suddenly develop fits in the later years of their service overseas.

The character of the fit is not really of importance as fits caused by the *Cysticercus cellulosæ* may simulate a true idiopathic epilepsy; the important fact is that the epilepsy usually manifests itself between the 22nd or 24th year.

It will be noted that neither of these cases gave a history of tapeworm.

Reference has been made to these cases by Colonel Mac Arthur in his recent paper on the subject in the *Transactions of the Royal Society of Tropical Medicine and Hygiene.*

I am indebted to Colonel Wallace Benson, D.S.O., Officer Commanding the Queen Alexandra Military Hospital, for permission to forward these notes for publication.

SOME OBSERVATIONS ON AN OUTBREAK OF ENTERIC FEVER.

By Major R. N. PHEASE,
Royal Army Medical Corps.

As a result of universal protective inoculation and modern hygienic supervision, an outbreak of typhoid fever is rarely seen on anything approaching epidemic scale among British troops living under peace conditions. The following is an account of such an outbreak which occurred in Lahore Cantonments in the early part of 1932.

The epidemic referred to was wholly confined to the 1st Battalion The East Surrey Regiment. It broke out with explosive suddenness, the first case being admitted to hospital on March 16, 1932. By April 15 eighteen cases had been admitted, after which date the epidemic ceased as suddenly as it had broken out.

Epidemiology.

The frequency with which the cases developed pointed to some infected article of food as being the most probable source. The water supply, being by pipe distribution and common to the Cantonment, could be excluded, as otherwise the epidemic would have been widespread and not confined to an isolated unit. The same applied, though to a lesser extent, to the milk supply, as all milk was, it was assumed, obtained from the military dairy. As a matter of fact it was subsequently proved that this was not wholly the case, and that the contractor of the regimental institute was in the habit of procuring milk from unauthorized sources. If, however, milk had been

the vector, one would have expected to find cases among the women and children of the unit, which was not so; and, moreover, it was customary for the contractor to boil all milk, not as a sanitary measure, but to prevent premature souring.

The further possible sources of infection therefore were as under:—

(1) A local carrier employed in a cookhouse or dining-hall.

(2) A carrier in the regimental institute.

(3) Infected food, introduced from outside and issued uncooked.

(1) The messing of the unit is done by companies, each company having its own dining-hall. If, therefore, a carrier was responsible, the cases would have been confined to one dining-hall and one company.

Although the majority of cases were confined to headquarters and "B" Company, they were not exclusively so, and had a carrier been responsible, two carriers, simultaneously active, would have been required. This, together with the fact that all the menial staff had been with the unit for some considerable time previously, and that no case of illness had been reported or was known of, made the possibility of the epidemic being due to a local carrier, employed in a cookhouse or dining-hall, unlikely.

The following is the percentage distribution of the cases by companies:—

Headquarters	38·8 per cent
"B" Company	38·8 ,,
"C" Company	16·9 ,,
"D" Company	5·5 ,,

"A" Company was stationed in Lahore and was consequently not involved.

(2) In order to ascertain the possibility of infection from the regimental institute or through the tea-hawkers connected therewith, the patients were questioned as to the frequency with which they visited the Institute, and the special variety of food partaken of. No single article was universally eaten. Tea from the tea-hawkers and oranges appeared to be the most popular. The tea was made in the Institute, milk and sugar added, and sent round in locked urns. All fruit was washed in "pinky" (dilute potassium permanganate) before being sold. Neither of these articles was therefore a probable source of infection. The remaining articles were too sparsely partaken of by the infected individuals to be likely agents.

(3) Infected food. In order to eliminate all likely avenues of infection a summary of all foodstuffs issued to the dining-halls was prepared. This summary is shown in the table. Of this list, the article most open to suspicion was the pork dripping, issued twice weekly in lieu of butter. This was obtained from two local piggeries and issued to the dining halls without any further treatment, such as re-rendering.

The issue of pork dripping was stopped on April 8, not as a result of these conclusions, but on account of the rise in daily temperature. The piggeries were visited with a view to carrying out an examination of the personnel employed, but unfortunately they had closed down and all personnel had been discharged. It was ascertained, however, that, after

being rendered, the dripping was stored in tins and scraped out as required. It is highly probable that this was done by hand, and thereby the dripping became contaminated.

TABLE.—FOOD SUPPLIED FROM COMPANY COOKHOUSES TO DINING HALLS.

Food	Frequency	Source of supply	Mode of preparation	Remarks
Meat	Daily	Ration stand ..	Cooked in cookhouse	
Breakfast meat	Daily	Contractors ..	Do.	
Pork mince ..	Thursday and Saturday	Piggery	Do.	
Liver	Weekly ..	Contractor ..	Do.	
Bread	Daily	Ration stand ..	—	
Butter	Daily	Government dairy	—	Also from unauthorized sources
Milk	Daily	Government dairy	—	
Pork dripping..	Thursday and Friday	Piggery	—	Issued in lieu of butter
Margarine ..	Daily	Contractor ..	—	Delivered in sealed tins
Beef dripping..	Daily	Contractor ..	Used for cooking only	
Tinned salmon	Occasional ..	Canteen	—	
Vegetables ..	Daily	Contractor and ration stand	Cooked in cookhouse	
Lettuce ..	Daily	Contractor ..	Washed in potassium permanganate in cookhouse	

The origin of the epidemic was thus never conclusively proved. It was so confidently felt, however, that the dripping was the probable infecting agent, that it was predicted no further cases would occur after April 26, 1932, allowing an incubation period of eighteen days as a probable maximum after the last issue of dripping. The last case was admitted on April 15, 1932.

In order to confirm the theory that typhoid bacilli could remain viable in dripping, a sample of pork dripping was obtained, tubed in test tubes and sterilized. The test tubes were then inoculated with *B. typhosus* and stored at room temperature for seventy-two hours. Sterile broth was then added, and the tubes shaken and allowed to stand for a further twenty-four hours. Sub-cultures were then made on litmus lactose agar plates from the broth and dripping, when pure cultures of *B. typhosus* were obtained.

COMMENT.

The following points are of interest in the series of cases under review:—

(1) The severity of the attack, even in a population fully protected by anti-typhoid inoculation. All the cases were seriously ill, many dangerously so, and three died—a mortality of 16·6 per cent.

(2) Of the eighteen cases, fourteen, including the three fatal cases, had been inoculated within the past seven months.

(3) Of seventeen cases, eight (49 per cent) had less than one year's service in India, and fourteen (82·35 per cent) had less than two years' service abroad. This incidence might be ascribed to the fact that older soldiers

have more experience in protecting themselves against infection; but it might also be argued that immunity is gradually acquired by swallowing sub-infective doses of pathogenic organisms, apart from protective inoculation.

(4) Out of eighteen cases of clinical typhoid, a bacteriological diagnosis was obtained in seventeen (94·4 per cent). In fourteen cases the organism was isolated by blood-culture; in the three cases where blood-cultures failed it was subsequently isolated from the fæces.

DISINFECTING WITHOUT HANDLING.

By Captain G. de M. RUDOLF, M.R.C.P., D.P.H., D.P.M.,
Royal Army Medical Corps (S.R.), Medical Superintendent, Brentry Colony.

A method of disinfection has been evolved to eliminate the handling of articles once they have been removed from the patient's bed until they have been disinfected.

The articles are removed and placed lightly, not packed tightly, in a canvas bag which hangs on hooks on a metal stand. The stand in use has

Fig. 1.—Stand for canvas bag (kept in ward) and tank with cage (kept outside ward).

a lid which is raised or lowered by foot action. A nurse whose hands are not infected closes the bag by pulling on tapes. This action also lifts the bag off the hooks. The bag is then carried to a wire cage which is in a

metal tank kept outside the ward. The tank, kept padlocked, is made of galvanized iron and has two outlets in the floor for allowing the escape of antiseptic fluid when it is sterilized. When the tank is in use these outlets are closed so as to prevent urine or other infected liquid from flowing on to the ground. The cage inside the tank is made of such a size as to fit the disinfector, in this case a Washington-Lyon's apparatus. When the cage is full, and no bag should be placed on top of another bag, the tank, containing the cage, is removed to the disinfector house. Here the cage is lifted from the dry tank by hook and tackle and, if it contains linen with albuminous matter upon it, is lowered into a tank of cold liquid. This

FIG. 2.—Cage, containing bags, being removed from steepage tank to be placed in disinfector without handling of articles.

tank will hold three cages one above the other, the lids on the cages preventing the articles from floating upwards. In practice it has been found that if this liquid is stirred and the cages remain in it for a few hours, no stains are left by the albuminous matter after disinfection. The cage is again raised by the hook and tackle, allowed to drain, transported along an overhead rail, lowered on to the disinfector rails, and pushed into the disinfector. Thus the whole process is carried out without any handling of the articles from the time they leave the infected patient until they are removed disinfected from the bags.

If there is no albuminous matter on the articles, the cage can be run straight into the disinfector.

The cold liquid for the purposes of the prevention of stains may be water, but "to make assurance doubly sure," a solution of disinfectant is used.

After coming out of the disinfector the articles are washed in the laundry with the non-infected linen.

The metal stand for holding the canvas bag is supplied by the Surgical Manufacturing Company.

My thanks are due to Mr. R. Welby, the Chief Engineer at Brentry Colony, for his assistance in the planning and carrying out of the above scheme.

Travel.

BEYOND LEH.

A SHOOTING TRIP IN LADAKH, 1926.

Being a Diary kept by

K. W. DICKSON, F.R.G.S.

(*Continued from p.* 70.)

IX.—NEARING LEH.

Nimu, May 4, the last stage before Leh.

The walk to Nimu was the best we have had since we left Srinagar. It was only 11½ miles, an easy march, first up a steep hill, then up a gradual slope until we were on the top of a fine broad plateau; there for the next three or four miles we could get into a good stride on firm, fairly level ground, with hills on all sides. There was a bitterly cold wind blowing and the sun hardly peeped out, but we kept going and enjoyed it thoroughly. For the first five or six miles there was no stream or water near us, not a house, or any kind of live stock.

We soon came to Basgu, set in a group of villages lining a fertile nullah which leads to the Indus. It must be hundreds of years old, yet it looked as if a shower of rain would knock it all down, but the shikari says rain never falls there, only snow in winter, so the ruins of these old mud castles still remain from the days of Queen Elizabeth. The light was far too bad for a photograph, which was a pity, as it was a most wonderful spot, and looked as if it might be inhabited by gnomes and goblins. There were places where one could picture a pied piper disappearing with his following crowd of happy children.

The crops were far behind those of Saspul, but Basgu is higher, and must be more exposed; the blossom was still on the apricot trees and in its glory, and very pleasing to look at against those austere hills.

We rested a mile or two beyond the village, then started across a plain which turned out to be deep sand, and very heavy going. The map was

very misleading, and we arrived at Nimu quite unexpectedly. From the map it appeared that we had another two miles to go along the river before reaching the village.

We laid out our lunch on a very dirty Dak Bungalow table. One table was scrubbed daily in each bungalow, which the servants thought quite unnecessary. What R. called my passion for cleanliness, was a point of view they could never understand; the shikari sent a message to me one day to say it was dangerous to have a bath when there was snow on the

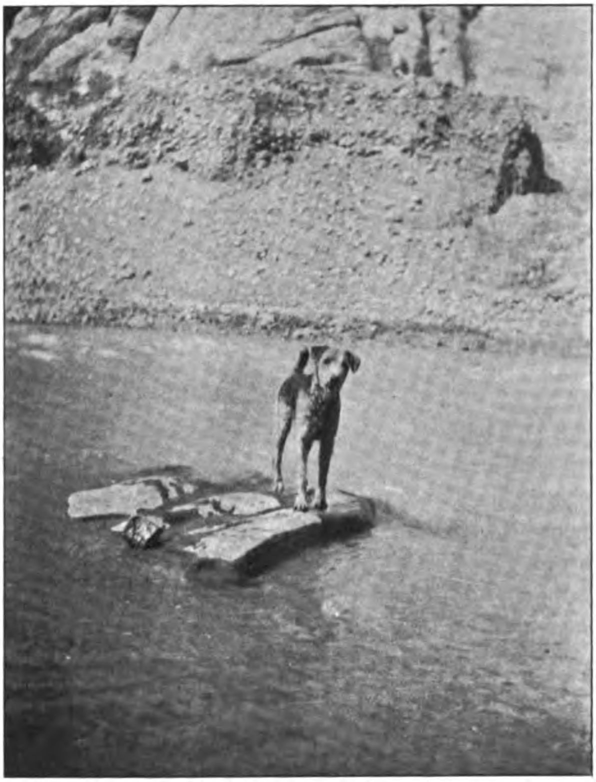

Fig. 8.—Garry on a rock on the Indus.

ground, and it was safer not to wash in cold weather. He shrugged his shoulders when he heard me talking to Jit Ram about having shirts washed. He was really quite kind and thoughtful for me, but he thought the memsahib and the dogs were quite superfluous on that trek.

We were very glad that I had taught our cook how to make different kinds of scones a year or two ago. We had neither oven nor a good wood fire, and baking bread was too difficult when we were moving daily. I hoped to have a mud oven when we camped for a few days in one place, little thinking there is often no sticky mud in Ladakh, only sand.

We arrived in Nimu really early, and I had a rest before tea, but was disturbed by Garry barking outside. The irrigation water had been let loose in the field above, and was coming down like a fast Scotch burn through the poplar wood in which the rest house stands. I expect the trees need a lot of water too, as the rainfall in that part is about three inches per annum; we often have that in Kasauli in a day.

It is a very good idea having the poplar trees round the house; the wind there rises in a minute, and you hear it rushing like a train coming into a station. All the poplars are bent to one side by the wind.

R. went out to look for more pigeon as the larder was getting low.

Lots of goats and tiny kids came to feed in the compound, and Garry found them very trying. He and Kelpie are very obedient now, and keep in to heel when told.

I found my topee was looking very shabby and faded in patches, so I gave it a coat of water-colour paint, which improved its appearance very much.

The water was so soft that I washed R.'s hair. (He had been using my hair brushes!)

There was a plague of tiny moths at Nimu, and they lay about in hundreds. I had never seen so many before.

I got into bed as soon as Jit Ram had removed the dinner dishes, and dropped off to sleep wondering what Leh could be like, a city in the midst of this desert. We were astir early next morning and eager to be on our way. The path wound up and up a steep gully. I rode up the first part of the way, and being so early and in shadow, it was very cold indeed. I had another nice grey Zanskar pony. We again came out on a high plateau with a grand view of the hills, but the going was hard, the surface was so sandy. Our feet sank in as we went along. We passed many laden donkeys with sacks of wool going to Srinagar. The guide book says that although pasture is so scarce in Ladakh, these barren hills support many thousands of sheep and goats, and all the wool for the well-known Kashmiri shawls comes from Ladakh.

Later we passed a caravan of ponies laden with earthenware jars; chatties, as we call them here, having come all the way from Skardu. These jars were packed in straw in large net bags on the ponies' backs. Even these jars must be comparatively expensive there, as they have to come so far. The cooking pots we have seen are made of copper. In Leh girls carried baskets made of grass and willow on their backs, with large copper jars for water inside the baskets. In Ladakh no one carries anything on the head as they do in India; even a baby sits comfortably in a basket on a woman's back.

The Tibetans are different in many ways from Indians. They are an honest, cheery little race, and not only are they honest, but they have a reputation for honesty, which is even more uncommon in the East. The shikari left our yakdans on the verandah in Leh, saying half in admiration,

half in contempt, when I asked him why they were not put inside, "Oh, memsahib, if you put a lakh of silver on your verandah at night, it would still be there in the morning."

A few drops of rain fell as we were having lunch, and we stayed for an hour and a half, it was so pleasant.

We passed Spittuk soon after that, with its rocky hill crowned by an old monastery, and in a few minutes the castle at Leh was in sight, the residence of the old kings of Ladakh. It looked three or four miles away,

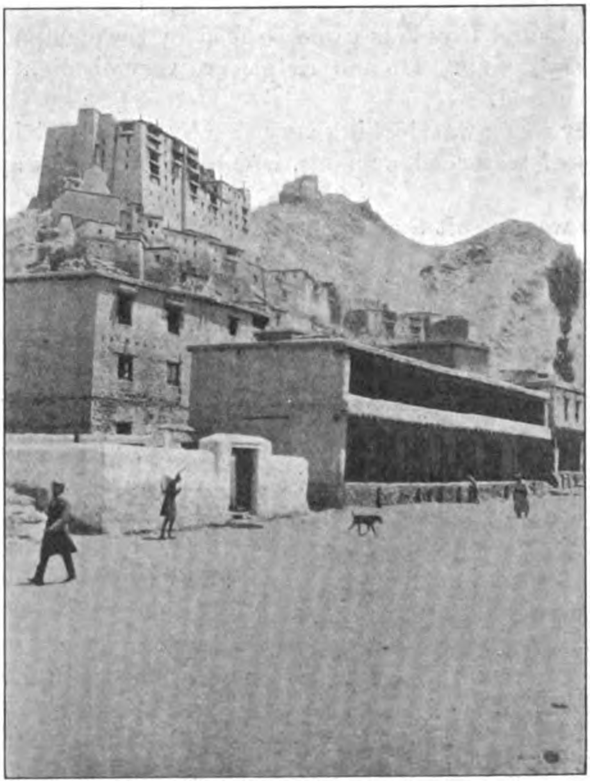

FIG. 9.—Leh. The castle and a monastery. Myself and Garry in the foreground.

but we little thought what a toilsome journey these 4½ miles were to be. There was not a blade of grass, a drop of water, nor any shade between Leh and Spittuk. In a country like this I understood afresh the words, "Like the shadow of a great rock in a weary land." The road lies across a sandy desert, and where it is not so sandy there are huge boulders. A storm of wind came across, blowing the sand in our faces; then snow began to fall as we entered Leh, but luckily the storm blew over for the time being. An hour later we could not see ten yards ahead from the bungalow windows.

X.—In Leh.

Two officers from Jullunder had arrived at the bungalow on their way back to Srinagar. Tea had been prepared for them on the verandah; however, they insisted on us having it, and I did appreciate their kindness. They had arrived in time for tiffin and had been to the post office to get their letters; they had seen no European for about a month, so were as glad to see someone as we were. One of them had been very successful in his shoot and had brought back a fine ibex head, and what his shikari

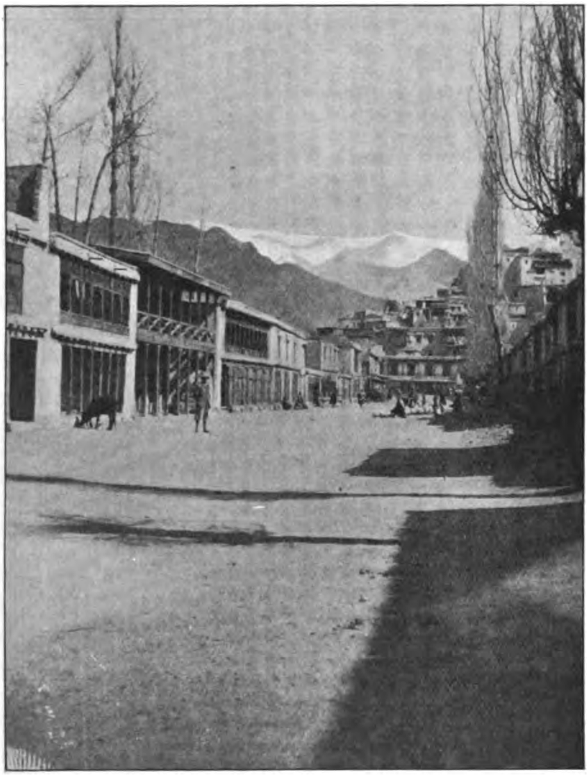

Fig. 10.—Leh. May 6, not a leaf on the poplars.

thought was a record burrhel. They both looked very good heads, especially the ibex, which had fine shaped horns with a wide sweep.

The entrance to Leh is sudden and unexpected. We were coming slowly up a lane with high walls on either side, passing lots of people and lots of cattle, when the tiffin coolies suddenly turned in at a gateway, and following them, to our astonishment we were in the bazaar, the main street of Leh; a long double line of shops, with a row of poplars on the sunny side, and rising straight up before us against the sky stood the old castle. It is one of the most picturesque places I have ever seen. For street

scenes and costumes I don't think it could be beaten, but perhaps it was the setting in a circle of snows that made such a wonderful background; women standing about talking, with these curious head-dresses and baskets on their backs; dear little girls with rosy faces, in leather caps with furry linings, and many, many pigtails down their backs. Further on were Lamas, with their yellow caps and long dark red robes; Yarkundi traders with quilted coats to the knee, long leather boots, and Cossack caps, quite apart in colour and dress from the Ladakhis, and a few Mohammedan shopkeepers wearing the fez.

Fig. 11.—A Ladakhi family.

I wonder if countries are like individuals; Ladakh must be very poor, and earns its daily bread by the sweat of its brow, yet the people are always cheery and jolly, and never ask for bucksheesh. So often individual people are like that, the well-to-do being too absorbed in prosperity to have time to realize they are happy.

After stopping up broken panes of glass with newspapers and a drawing board (it was freezing hard), we sat down to read our mail, and then to bed, dropping off to sleep with the happy thought uppermost that we could

sleep until 7 or 8 o'clock next morning, as we were spending two nights at Leh.

The best laid schemes o' mice and men gang aft agley! We woke quite as early as usual to the sound of guns, and many of them too. It was the salute being fired at 5 a.m. from the fort to celebrate the arrival in Srinagar of the new Maharajah of Kashmir. We were so sleepy, and just as we were dropping off to sleep again, more guns were fired. I'd certainly give these Gurkha gunners full marks for early rising.

Next day we spent in shopping and in repacking boxes so as to make

FIG. 12.—Leh. Three Yarkundis.

room for all our purchases. All the stores procurable were last season's, as the pass was not open for pony transport. Parcels up to four pounds in weight are accepted by the post office, but nothing heavier until the upper path on the Zoji La is open for ponies, usually about the beginning of June, but this year snow fell much later than usual.

I found some magazines and American newspapers that we could spare, so I gathered up my courage and went down and called on the missionaries while R. wrote his home letter. I found them to be delightful people, and

I stayed and talked for fully an hour. Mrs. Kunick had not seen a white woman in Leh for over six months, and remarked how early in the season we had come up. The postmaster had told us that he had never known a lady come up to Leh in the beginning of May, but I had not paid much attention to him. Mrs. Kunick is the only white woman there through the long winter. They asked what the Zoji La pass had been like when we came up, as the mail had been so irregular, they thought it must have been closed for days at a time. We knew our letters to Kargil had taken thirteen days from Srinagar, as the pass had been closed for several days with snowstorms.

The Kunicks showered all sorts of kindness upon us in the way of potatoes and dried vegetables, and Mrs. Kunick lent me her Ladakhi saddle, which was well padded, and much more comfortable than most.

That night in Leh I was too tired to write up the diary. It seems extraordinary that doing a little shopping and talking should make me so tired, but we had been doing neither for some time.

In Ladakh servants do not live in small quarters in the garden as they do in India. Indoors they have only women servants who come in daily, going home for their meals at two hours at a time; they get Rs. 10 a month, about 15s. 6d.

The Kunicks said they used very little in the way of English groceries and stores, and what they do get, they order by post, as it is cheaper that way. They store their own dried vegetables in a cellar, but they are not always successful.

At that time there was no qualified doctor in Leh, but arrangements had been made to have one up for a month or two while the British Joint Commissioner was there.

Mrs. Kunick was so cheery and had such a happy temperament, it was a pleasure to be near her; she simply hadn't a grouse, and what a long winter they must have had!

The pond in front of the Dak Bungalow was covered with an inch of ice that morning, May 7.

The missionaries wear Ladakhi clothes in winter, made of thick homespun cloth, and reaching to the ankles; they also wear the real Tibetan boots, just like the ones our pony men wore.

Many people suffer from eye trouble in Ladakh, and come to the Moravian Mission Hospital for treatment. The Kunicks said they would be very glad if R. would operate on some cataracts on his way back, and they would send word to the villages that a doctor was to be in Leh.

XI.—Beyond Leh.

We left Leh so early next morning that passing through the bazaar the street was empty, and the shutters were up on all the shops.

This was the beginning of the old path to Lhassa on which we were now going; the path that joins Eastern and Western Tibet. It wound

downhill across sandy deserts, passing the longest and biggest Mani walls in Ladakh. Then the valley opened out and our way lay among meadows, and when the sun came out, it almost seemed as if we were back in Kashmir. The country seemed much more fertile here, and so more prosperous ; water was abundant, and ploughing was in full swing, accompanied by the doleful chant of the workers.

The monastery at Tikse stands on a high rock, and we passed quite close beneath it. The north side had very few windows ; but the front was most imposing, there were dozens of windows, and each had its own little wooden balcony. Windows in better-class houses and monasteries have little wooden shutters, but except in one or two houses in or near Leh, I never saw any glass.

Later Mrs. Kunick told me about the Skushog, or head of the monastery at Tikse. When a Skushog dies, another man is appointed, who is supposed to be the re-incarnation of his predecessor. The present Skushog was found in Lhassa, the son of a wealthy merchant. The lamas said to the merchant, "Your son is the re-incarnation of the Skushog at Tikse; we know it because of the day of his birth, his features, and the pock marks on his face." The father told the son, who was very angry, and said he did not want to be a lama. The lamas, of course, have a great deal of authority, so the boy was taken to Tikse, much against his will, where he lived a life very different from that of the hermit and saint he was supposed to be. He heard about the outbreak of the war, ran away from the monastery, and went down to India, where rumour said he gained credit as the servant of a General. Later he returned to Ladakh, and even found a sanctuary in the compound of the missionaries, where he cooked his own food. He wanted to be baptized a Christian, but neither he nor the missionaries were sure of his belief. His wish may have been policy, as he was afraid to return to Tikse for fear of being poisoned. No new Skushog could be appointed until after his death, so as the lamas were losing much prestige on his account, his death was desirable. It all seemed a sad story of a young man with brilliant qualities having been pushed into a position for which he was quite unfitted.

The road had mud walls on both sides, and was often the irrigation channel of the district, so we were constantly jumping from side to side to avoid the water. The scenery was monotonous, every two or three miles a willow grove, but usually deep sand everywhere. At last we felt we could go no further without tiffin, so stopped under a double row of poplar trees. We had come about fifteen miles, but there are no milestones beyond Leh, so we were not sure of the distance.

The shikari had intended to go on to Ugu, but he had very little idea how far it was from Leh ; it was fifteen miles further on. When he arrived with the baggage we decided to pitch the tents in a so-called garden in the village ; a walled-in space where there were a few trees, and there we stayed the night very comfortably, our first night in tents.

I think we got away just as quickly next morning, in spite of the extra work of striking tents and folding up beds. I had such a nice little pony man from Leh to Ugu ; he had such a kind old face. He spoke Hindustani well, and said he had learned it in Leh. I tried to get him to tell me a few words in Tibetan, such as horse, saddle, whip, reins ; at first he could not understand, then it dawned on him, and he said, "sumachgya, sumachgya, huzoor, I understand, I understand, your honour." Then with obvious pleasure he entered into the spirit of my lesson, and I learned a number of useful words.

His pony was not so charming ; I think it must have had a sore back, for when R. got on, it bucked and bucked, and he had to dismount. I gathered up my courage and got on again later, and it behaved all right to my surprise and relief, until we arrived at our destination.

A herd of donkeys passed coming from Chimre, a young girl driving them. I saw something in her arms, and it turned out to be a baby donkey. I asked the pony man to call to the girl to let me see it. It was a fluffy little thing, smaller than Garry ; it was only a few hours old.

Another long stretch over a sandy rocky valley with a hill straight ahead, then through a gully to the left of it, we followed the path to the little village of Ugu. There were many fields, but ploughing had not started. Ugu must be about 12,000 feet high, so sowing is later than it is at Leh. We had lunch sitting on close-cropped turf among boulders by the side of a stream. We had outstripped the baggage that day but it soon arrived, and our camp was pitched in another turfy field just behind, a very pleasant sheltered spot. Big storms came up from both sides of the valley. The shikari hammered the pegs well in, and the servants made a trench round the tent to keep us dry underfoot. We wandered about in the evening with the gun, and R. got five pigeon.

We started off next morning in brilliant sunshine at half past seven. This was much later than usual, but it was snowing so hard earlier, we thought we would have to stay for a day, the tents were so wet ; however, the sun and wind soon dried them. It was a perfectly beautiful morning, snow all round, and the sandy road just moist enough to make walking a pleasure. For once in Ladakh there was no dust ; although the air is so clear the almost entire absence of rain makes the ground so dry that we were constantly covered in dust.

R. saw more chikor and went over a plateau by the old road, while we followed the lower path by the river bank under steep bluffs. I saw a black and white duck flying over the river, and then looking ahead there were two animals like deer or gurrhal leaping up the bluffs. I asked Burra Subhana what they were, and he said female sharpu. Garry was after them at once, giving tongue as he bounded up the cliffs. R. saw him on the plateau above, but did not see the sharpu. We went on about a mile, but as Garry did not come back in spite of much calling, I clambered up the bluff, but he appeared by the river just as I got to the top, so I went on to look for R., and wandered about for twenty minutes thinking he was

bound to appear. The Ladakhi pony boy came after me and showed me R.'s footprints, so I knew he must have gone on. I followed the old path to the edge of the cliff, when I saw R. and Garry with the tiffin coolies. There were some chikor about, and R. got one before I clambered down.

The shikari pointed out Upshi on the other side of the river, the beginning of the path to Simla, which goes by Gya, but was not open so early in the season. Later a beautiful golden eagle passed overhead, circling round and round above us. I had watched one near Moulbeck, but never so close before.

It was very warm crossing a sandy desert, but in ten minutes the sun disappeared, and we struggled on uphill between cliffs, a piercingly cold wind against us. We thought we would have to stop for tiffin behind a Mani wall; however, a sheltered spot was found behind a dry stone dyke, and there we shared our cold chicken with the dogs.

Our two lunch carriers, our personal coolies, are called Subhana—a common name in Kashmir. One man is very powerfully built and big in every way; the other is smaller and has such a thin face, he almost looks as if he were suffering or in pain. The big one is known as Burra Subhana, and the other Chota Subhana. Burra Subhana called just as we were settling down to the chicken that a fox was within range, but the rifles were with the baggage, and there were no suitable cartridges for the gun, so we ate our chicken and didn't see it.

The transport, consisting of six yaks and five ponies, passed us there; a dear little foal just bigger than Garry was with one pony. It trotted along the whole fourteen miles with its mother, and about 4 o'clock started back to Ugu. Poor little beast! It is no wonder that horses are mis-shapen here, if they go distances like that, nearly thirty miles, when a month or two old.

In Sherra crowds of children sat on a mound behind the camp and watched us. R. took a photo of the yaks, but the light was too bad when the children were there, or we would have had a nice group of them.

It was a long march and a difficult road to Yiamia or Hamia, our next camp, but it was all very interesting. Soon after leaving Sherra we saw a mountain hare loping along beside a Mani wall. R. got a cartridge ready and I held the dogs while he went on and got it; a great addition to our larder.

It was much colder than starting from Ugu, and we were much cheered when "the glorious lamp" came out. There were fields a few miles further on. I was riding ahead when R., seeing some pigeon, called to me, and gave me the loaded gun and sent me forward to stalk them. I took off my topee and walked behind walls for 100 yards, bending low all the time; the first lot of pigeon all flew away, but seeing more in the next field, I went forward and got one. I hated having killed it and picking it up. I would never shoot birds for sport, but we needed game of any sort for the larder. The servants had had nothing but bread and salt for days, and they did not complain. R. wanted me to be able to shoot with the gun in

case we ran short of food when he was up a nullah after burrhel. I would have liked to get a fox with my rifle, as they go after lambs and kids, but birds with the gun did not appeal to me.

We crossed the Indus by a wobbly bridge before Likche; here the baggage had all to be unloaded and carried across in single bundles; the yaks' heavy weight weighed the bridge well down as they crossed.

We lay on a delightful bank of turf for half an hour while yaks and ponies were loaded up. Beyond Likche the road was a mass of boulders, and going was very slow. Tremendous granite cliffs towered above us, but we could not look up often, as each step had to be taken with care; the path was broken almost the whole way to Yiamia. Those cliffs were a rich burnt sienna turning to gold in the sunshine, but when the rock has been broken by falling boulders, it is a real Aberdeen granite colour; it is only brown and scaly on the surface from the action of the weather. The quartz between the granite glistens with mica, and is very dazzling in the sun.

We started our meal cheerily, sitting by a small backwater of the Indus in warm sunshine, but soon had to hurry, as once more a piercing wind came up the gorge. A specially fine yak passed us, a grand tawny colour, with hair hanging beyond its hocks, and a tail as long as any pet pony's. They carry very heavy loads, and come on at a good pace.

A herd of burrhel were playing about and grazing on the far side of the river as we passed, about thirteen of them, and although Garry went right down to the bank, they only moved a few steps on; there were no full grown rams amongst them.

The shikari pitched our camp by the banks of the river beyond Yiamia quite near another bridge. We gave the servants three pigeon and a chikor and had pigeon for our own dinner, and so to bed by 8 o'clock, with the roar of the river to put us to sleep.

(*To be continued.*)

Echoes of the Past.

THE ARMY MEDICAL SERVICES AT HOME AND ABROAD, 1803-1808.

By Lieutenant-Colonel G. A. KEMPTHORNE, D.S.O.,
Royal Army Medical Corps (*R.P.*).

The Army at Home.

The Peace of Amiens was signed in March, 1802. In less than a year we were making preparations to renew the war against Napoleon. By the spring of 1804 the armed forces in Great Britain and Ireland amounted to 510,000. Large camps sprang up in Essex, Kent and Sussex. Two general hospitals already existed, the York Hospital, Chelsea, and the Hospital of the Hanoverian troops at Ealing. Others were now opened in hired buildings at Plymouth, Gosport, Deal, Yarmouth, Chatham, Dunmow,

and Edinburgh, and numerous depots of hospital and purveyors, stores were formed. The perennial controversy as to the respective merits of staff and regimental hospitals was renewed. The latter continued to operate, and there was lack of co-operation, if not open hostility, between Thomas Keate, Surgeon General, who controlled the one, and Francis Knight, the Inspector-General, who inspected the other.

The chief medical officer of a general hospital, styled the P.M.O., was appointed, presumably on his merits, but without regard to seniority of rank or service, resulting in much dissatisfaction among the regular officers. The kind of staff provided may be seen from that of the General Hospital, Gosport.

Military Superintendent	15s.	Resident Mate ..	7s. 6d.	Steward ..	2s.
Staff Surgeon as P.M.O.	20s.	4 Hospital Mates ..	6s. 6d.	Surgery Man ..	1s. 1½d.
Physician	20s.	Purveyor's Clerk ..	3s.	Wardmaster ..	1s. 1½d.
Staff Surgeon.. ..	15s.	Matron	2s. 6d.	Porter.. ..	1s.
Apothecary	10s.	Head Nurse ..	1s.	6 Orderlies ..	1s.
Deputy Purveyor ..	10s.	2 Nurses	1s.		(if soldiers, 3d.)

In 1807 the general hospitals with the exception of the York Hospital and the so-called Depot Hospital were closed down. The last had been moved from Chatham to the Isle of Wight. The foreign hospital at Ealing was also retained.

Since the Duke of York's accession to the command of the Army there had been a definite improvement in the public attitude towards the private soldier and regard for his welfare. Though the maintenance of the men's health, when not in hospital, was as yet barely recognized as part of the surgeons' duty, some credit at least must be attributed to their efforts. Sir James McGrigor described how when he was surgeon of the Connaught Rangers, Beresford, newly transferred to the command of the regiment, took him to task for the large number of sick, declaring that half of them were malingerers. McGrigor, greatly aggrieved, retorted that the filthy state of the barracks was more than sufficient to account for the crowded hospital. Challenged to make good his accusation, the doctor was ordered to follow the C.O. through the lines. "When, after two hours of this unpleasant duty, the Colonel had gone through the whole, I begged him that he would accompany me and see the only place over which I had jurisdiction, the hospital. He passed in silence through the different wards, but this I could not permit. I called upon him to say if he found fault with the conduct of things there. He confessed he could not. He did more; for he desired the officers commanding companies to go in, as he had done, and view the comfort men could be placed in, and mark the contrast."

Robert Jackson's work "On the Formation, Discipline and Economy of Armies," first published in 1804, and dealing with military hygiene in its widest aspect, owes its importance to the fact that it was read and appreciated by the senior combatant officers of his day.

There remained ample scope for improvement. The bulk of the regular

troops at home were now housed in barracks instead of being billeted in public-houses, but the amenities provided were few. Unflushed privies were everywhere associated with shallow wells for drinking-water; all cooking was done in coppers. Forty years later, out of nineteen barracks in the North British Command only three had ablution rooms. But the main reason for the excessive mortality of the home Army as compared with that of the civilian population was the crowded state of the barrack rooms, where the living space, already too small, was further contracted by the tiers of wooden beds in which the men slept four to a tier, and by the curtains hung by the married men to ensure a little privacy for their families. Under such circumstances tuberculosis spread and the louse-born diseases were disseminated. Writing of the York District about 1806, McGrigor said, "From the very commencement of the war, typhus was more or less prevalent in every corps. It prevailed likewise in civil life. At the beginning so great were its ravages that half the sickness of every regiment consisted of low fever and ulcers of the legs. The report got wind that if the sores were not readily cured the man would get his discharge, and hence there was a general manufacture of ulcerated legs." McGrigor introduced a new conception of the work of Deputy Inspector by interesting himself in the professional work of his officers. The improvement in the health of the troops which he succeeded in effecting he ascribed largely to the adoption of the cold water treatment of fever recommended by Dr. Currie of Liverpool and Robert Jackson, and Dr. Baynton's treatment of ulcers by adhesive strapping.

The officers of the Army Medical Department, as distinguished from the regimental surgeons, do not appear in the Army List before 1812. A Blue Book of 1807 shows the Department to consist of Sir Lucas Pepys, Physician General, Thomas Keate, Surgeon General, and Francis Knight, Inspector of Regimental Hospitals, 8 Inspectors of Hospitals, 1 of whom, James Borland, was deputy to Knight, 17 Deputy Inspectors, 17 Physicians, 60 Staff Surgeons, 8 Purveyors, 14 Deputy Purveyors, 16 Apothecaries, and 126 Hospital Mates.[1] The Army in Ireland, 20,000 strong, had its own establishment. The Ordnance Medical Department providing for the artillery and engineers, formed in 1801, had at its head Sir John Macnamara Hayes.

Events Abroad.

The Second Mahratta War, 1803-1805.

Since Eyre Coote's defeat of the French at Wandewash in the year 1760, the Honourable East India Company had been involved in a series of wars with various Indian princes. In May, 1798, the capture of Seringapatam had brought the long drawn out contest with the ruler of Mysore to a conclusion, and Colonel Arthur Wellesley, who had been a divisional

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[1] For details *vide* Fifth Report of Commission of Military Inquiry.

commander in the campaign, was entrusted by his brother, the Governor General, with the final pacification of the territory.

Since 1755, when the 39th (1st Dorsets) arrived in India, the Company's European regiments had been supplemented by further reinforcements of the King's troops. In April, 1800, there were three cavalry regiments and seventeen infantry battalions distributed throughout the Peninsula, a total of 16,000 men. The surgeons present with their regiments at this time numbered fifty-one.

The Medical Department of the Madras Presidency, with which we are now mainly concerned, was controlled by a Board consisting of the Physician and the Surgeon General. Of the Company's surgeons, about a third were in regimental employ, the remainder being distributed in various garrison charges. The last were sought after as being the most lucrative, but it seems to have been within the scope of the regimental surgeons to make considerable profits on hospital dieting and the contract for country medicines. The medical officers of the King's Service were all regimental. They were their own purveyors, except as regards European medicines, which were issued in kind, and accounted for to the Company's District Superintending Surgeon. We have Wellesley's testimony to the excellent order of the British regimental hospitals in the Presidency in the last year of the century, and particularly of his own hospital, that of the 33rd, where the surgeon, Mr. Trevor, was engaged continually from 7 to 11 a.m. and from 3 to 5.30 p.m.

In 1802, thanks to Napoleon's intrigues, another Mahratta War became inevitable. Preparations were accordingly made for the despatch of two armies, one under Wellesley in the South, and another under General Gerald Lake in the North. The latter was concentrated round Lucknow. Wellesley's troops were drawn from the Madras and Bombay armies, and he set about his preparations with the thoroughness of detail associated with all his undertakings. Calculating for a strength of 3,000 Europeans and 15,000 natives, impedimenta were rigorously cut down, while retaining all essentials and a reasonable standard of comfort for the troops. Public followers, hitherto reckoned at four per fighting man, did not exceed a quarter, and private attendants were greatly reduced.[1] The P.M.O. was Alexander Anderson, Superintending Surgeon of Mysore, described by Wellesley as the ablest man of his profession in the country. The regimental medical establishments proceeded intact. The Indian corps had their usual allotment of one assistant surgeon. Each British hospital had besides its surgeons an apothecary and a full menial staff. Doolies for British were provided at the rate of twelve per cent. Under the General's instructions they were not, as was usual, detailed to units, but pooled under the direction of the senior surgeon. He also insisted on the provision of a general hospital complete for the Madras contingent, including a staff of

[1] The allowance for the war of 1792 was 10 for a subaltern and 40 for a major.

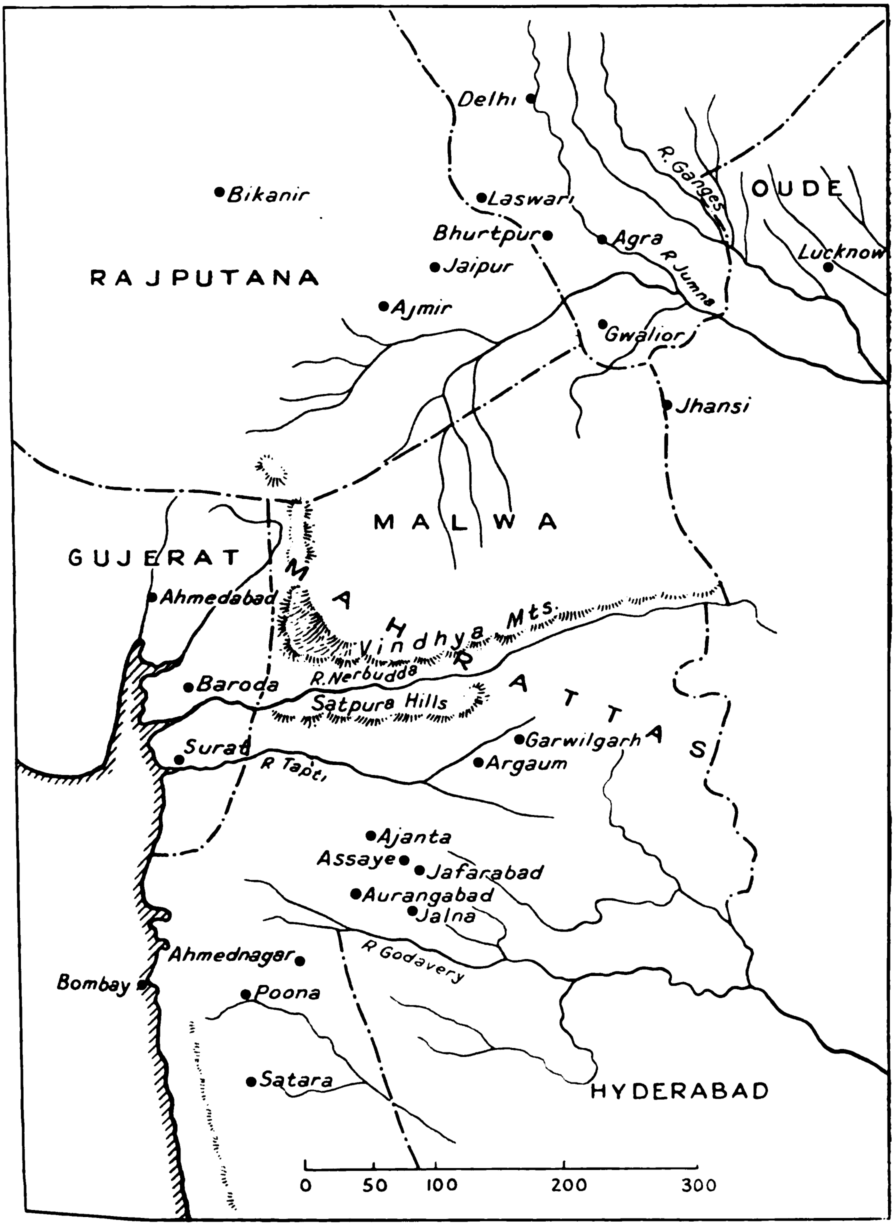
six surgeons, two compounders, and a stock of clothing, medicine, and servants. In previous Indian wars these had been supplied by depleting the regimental establishments. Writing to the Commander-in-Chief he said he supposed it impossible to alter existing arrangements for the carriage of native sick, though it was probably the greatest abuse in the Service. This referred to contracts made by commanding officers with the H.E.I.C. He kept a close eye on it, however, and, in one case at least, where he was dissatisfied with the provision made, he inflicted a fine and published the Colonel's name in general orders. Three months medical supplies for Europeans were carried in the bullock train, and the same amount was in reserve, particularly bark, Madeira wine, mercurial ointment, and calomel, not forgetting nitrous acid.[1] The last was for fumigation. At Hurryhur, the place of concentration, both British and Indian hospitals were ordered to be constructed.

Wellesley's views on the disposal of casualties on the march were expressed in a despatch to Colonel Stevenson, who, with the Hyderabad Contingent and H.M. 94th, was watching the northern passes of the Nizam's Territory, May 2, 1803. "You must immediately establish a hospital. Look for some secure place for this, and leave all the sick of the Scots Brigade that require carriage, otherwise the first action will be ruinous to you." The order was disliked both by the surgeons and their C.O.'s who were accustomed always to carry their sick forward with them.

In April, Wellesley left Hurryhur, and, on the 20th, was at Poona. The force consisted of the 19th Light Dragoons, then a Company's Regiment, 3 regiments of Native Cavalry, H.M. 74th (H.L.I.), 78th (Seaforth), 6 battalions of Madras sepoys, 14 guns, and Pioneers. Surgeon James Gilmour, Madras Army, was his Senior Medical Officer. War was declared on August 6, and on the 11th Ahmednagar was taken by assault at the expense of 30 killed and 141 wounded. Here the casualties were left, and an advanced base was established. In the meantime Colonel Stevenson was operating between Aurangabad and Jafarabad. Moving through wasted country, and with considerable difficulty in transport and supply, Wellesley reached Aurangabad on August 29. The Godavery river was crossed in wicker boats covered with bullock hide which were made by the troops. The rains rendered the black cotton soil difficult for wheeled traffic. On September 1, he was at Unterwarry, where an Indian battalion with one surgeon from each brigade was left in charge of the sick, convalescent, and weakly. On September 21, the two British columns were within twelve miles of each other, north of Jalna, and a plan was concerted for a simultaneous attack on Scindias camp. But the enemy's position was miscalculated, and, on the 23rd, Wellesley with 7,000 men came on their main body, 38,000 strong drawn up near the village of Assaye. Leaving

[1] Wellington's Dispatches, the authority for all administrative details in this campaign.

his stores and transport at Nalni, five miles from the point of attack, he advanced on the opposing host. The course of the battle, which lasted



from 3 to 6 p.m., was critical, but in the end the British regiments saved the situation, a complete victory being won with the loss of 31 officers and 392 men killed and 59 officers and 1,110 men wounded. The number

actually under fire did not exceed 4,520. The 74th regiment alone had 401 casualties.

The army spent the night exhausted on the field. Stevenson's force arrived but could not take up the pursuit as all his surgeons and kahars were needed for the wounded. Even so, it was a week before they were all dealt with. A hospital was formed at Ajanta in a serai, twelve miles from the battlefield; the wounded were classified as walking cases, those requiring doolies, and those capable of riding on elephants, horses, or bullocks. On the 30th the following order was issued. The 1/10th and 2/12th to furnish each a dresser for the Field Hospital. The staff surgeon to furnish servants and European medicines so far as his stores permit, and is authorized to purchase 10 dozen of Madeira wine; 20 pioneers are to be detailed under the staff surgeon; each unit to supply one tent for every 10 men in the Field Hospital. Wellesley, who was still at Ajanta on October 8, attended personally to the patients' comfort. Each of the wounded officers of the 78th received a dozen of Madeira from his private stock. Soon after the battle he asked for six more assistant surgeons to be sent up. He stated in his letter that a large proportion of the wounds had been caused by cannon balls, which would cause permanent incapacity, and that doolies should be arranged to take the invalids to Bombay, whence the Europeans should go to England and the Indians to the Coromandel coast.

On November 29, Wellesley and Stevenson again beat the enemy at Argaum, where our losses were 46 killed and 308 wounded. On December 15 the fortress of Garwilgharh was assaulted with 125 casualties, which brought the war in the Deccan to a conclusion.

Wellesley was well served by his senior medical officer throughout. In those days mentions in dispatches were reserved for officers of the combatant branch. In refusing, however, to nominate a gentleman with influential connections as staff surgeon at Poona, he wrote that he could not disappoint the expectation which Mr. Gilmour had a right to form of promotion, "and in his person violating the principle that those who do their duty to the army ought to enjoy its benefits and advantages." The British Service medical officers at the battle of Assaye were Surgeon John Abercromby and Assistant Surgeon John Murray with the 19th Light Dragoons, and Assistant Surgeon Alexander Young with the 78th. The Medical Staff of the 74th, according to the Army List, were M. Gallaher, J. Andrews and M. Christy.

The General showed his appreciation of the good work of the native doolie-bearers by securing for them a special bounty.

Lake's campaign, though no less important, must be followed more briefly. The army, which was concentrated at Kanauj in August, commenced operations in the traditional way, with tent equipage which included a ball-room. Major Thorn, the historian of the war, estimates the number of followers as ten times that of the troops. The soldiers had a water-carrier and cook-boy to every tent of twelve men and a cook to every

two tents, but this availed them little in some of their terrible marches in the early summer through the desert, when the regulation tents were uninhabitable, and the hot wind and driving sand blistered their hands and faces. During one week in May we are told that they were falling and dying from heat-stroke at the rate of ten to fifteen a day. The King's regiments employed were the 8th, 27th and 29th Light Dragoons, and the 76th (2nd Duke of Wellington's). Of the Indian regiments one, the 7th Rajputs, still remains in the Army List. There was much hard fighting, the engagements including the assault on Aligarh on September 4, the battle of Delhi on September 11, and on October 31 the battle of Laswari. In 1804, Lake turned his attention to Holkar, and fighting continued till late in 1805. The attempt on Bhurtpur in February of that year was a most bloody affair costing us 3,000 casualties.

Sickness was heavy during this campaign, the ineffectives numbering at times nearly a quarter of the strength. The chief medical officer was Peter Cochrane of the Bengal Medical Department. After the battle of Laswari, Surgeons W. H. Lyss and Samuel Newman[1] of the 29th Light Dragoons were called in front of their regiment to receive the thanks of the Brigadier for "their humane and successful exertions in bringing off the wounded of the brigade at great personal risk."[2] The medical officers of the 76th, which covered itself with honours in the campaign, were Surgeon Charles Corfield and Assistant Surgeon W. Bean. The latter was wounded at the battle of Deig on November 13, 1804, when the battalion had 162 casualties. Three of the Company's surgeons, Surgeons Hooper, Brugh, and J. Lyons were killed in the war.

(*To be continued.*)

Current Literature.

Mac Arthur, W. P. **Cysticercosis as a Cause of Epilepsy in Man.** *Trans. Roy. Soc. Trop. Med. and Hy.*, 1933, xxvi, 525.

After a brief survey of the occurrence of the cysticercus stage of *Tænia solium* in man, the author states that on an average ninety-seven men have been discharged annually from the Army for some years on account of epilepsy developing usually in adult life or after service abroad.

In order that special investigations may be made, all epilepsy cases occurring in soldiers are now sent to one military hospital. Of the last twenty-two of such cases admitted to this hospital, ten have been proved to be suffering from cysticercosis. The author considers that many similar cases have been missed in the past, and states that he has seen six ex-soldiers invalided for epilepsy and who suffered from cysticercosis;

[1] Samuel Newman was a man of many parts. He was Assistant Surgeon 1797, Veterinary Surgeon 1800, Cornet 1803, Captain 1811 (*vide* Johnston's Roll A.M.S.)

[2] W. Thorn. *Memoir of the War in India conducted by General Lake.*

he has also seen twenty proved cases of cysticercosis, and has received reports of others.

The infection rarely gave rise to general symptoms during the invasion stage, the patient usually only noticing small subcutaneous or intramuscular swellings. In rare cases, a condition resembling typhoid fever occurred, and in others cysts were only found on radiological examination, probably undertaken for some other reason.

The fits may be of the Jacksonian type or of the true epileptic type.

In one case seen by the author a diagnosis of cerebral tumour had been made previously, although cysts were palpable. One patient showed symptoms resembling those of disseminated sclerosis, while severe lapses of memory were the first symptoms in a man who later, two years after leaving India, developed fits of an epileptic type, and at this time cysticerci were found in excised cysts.

In most of the cases which have come under the author's observation no history of tapeworm infestation was obtained, but in one case fits first occurred while the patient was undergoing treatment for tapeworm.

In one case fits developed four years after the removal of a tapeworm.

In cases of from four to five years' duration the larvæ are found to be calcified, and in this stage they may be shown by X-ray examination, although in the uncalcified state they cannot be detected by this method.

Complement-fixation tests were performed by Dr. Hamilton Fairley on a number of these epilepsy cases, in nine of which cysticercosis had been diagnosed. In five of these nine cases the test was positive, doubtful in one and negative in three.

Two of the cases under the author's observation were being treated by intravenous injections of antimony tartrate. He does not consider that surgical treatment is advisable in this disease.

ZACHARIN, DAVID. **Plane Tree Leaves a Cause of Seasonal Asthma and Hay Fever.** *Med. Journ. of Australia*, 1933, I, 467.

Dr. Zacharin records the case of a male employee, aged 35, of a suburban council in Melbourne, whose duties included the pruning of trees in the streets and gardens of the municipality, and who stated that whenever he was employed in the pruning of plane trees in the summer, he became afflicted with hay fever and attacks of an asthmatic type. Other trees did not affect him, nor did plane trees at any other time of the year.

Cutaneous scratch tests were carried out with a watery suspension of the downy material with which the leaves of plane trees are covered in early summer, with a suspension of pollen from the seed balls of the trees, and with cocksfoot and rye grass pollen extracts. It is stated that the only positive reaction was a marked one to the downy material from the leaves of plane trees.

The author has had no opportunity of attempting to desensitize the patient by injections of an extract of the substance.

Activities in the Medical Inspection Room. *The Berliner Illustrierte Nachtausgabe.* March 7, 1933.

Every day, when early in the morning the N.C.O. on duty makes his rounds of inspection in the barracks, he asks: "Any sick?"

"All well," replies the senior in the room, or, perhaps, Driver Mayer or Acting Corporal Muller.

Any man who is not at his post reports himself sick and must attend sick parade in *the medical inspection room.*

The men report there at 7.30 o'clock. The medical orderly makes the first superficial examination. The staff surgeon arrives at 7.45 o'clock; the new cases are presented to him and he visits and inspects the old patients in the sick rooms.

In the meanwhile we will look round the medical inspection room, where great activity reigns to-day.

"Two fillings; three fillings, fourth missing; six fillings, bottom jaw, right, no teeth missing. Bottom jaw, left, no teeth missing. Three fillings, four fillings, six decayed teeth."

A group of young men in civilian clothes and half undressed are standing about. They have reported for military service and are being medically tested. At this particular moment, their teeth are being examined. They step forward, one by one; a medical orderly examines their teeth and calls out his findings in a loud voice, while another orderly writes everything down most carefully: "Two fillings, four fillings, sixth missing . . ." The door is thrown open, "Attention!" rings out and the staff surgeon returns from his inspection.

Accurate Book-keeping.—In the medical inspection room, the surgeon once more inspects the "books." In the regimental sick report register the name of each man who has reported sick is entered, together with the nature of his complaint, whether he is entirely or partially exempt from duty and the date of his discharge. Besides this, the prescription given to the man, his treatment and the history of the disease are entered in the "*Sick Report.*" In a third book are entered particulars of the dates on which the wives and children of members of the Defence Force have appeared before the staff surgeon, with the reasons for their doing so, or the date on which the medical officer visited them in their homes. Medical care is given free of charge to the relatives of soldiers belonging to the garrison.

Preventive Measures.—"Nowadays, the soldier is better off than the panel patient," says the staff surgeon, "not only because he and his family receive all treatment free and he draws his pay during sickness, but also because so much is done for the prevention of disease. He can report whenever he has some ailment or does not feel quite fit. All the men are medically inspected every month, they are weighed and measured every six months. When the examination in the regimental medical inspection is not conclusive, the patient is immediately handed over to the garrison

hospital and taken to a specialist. In addition to this, we are at present engaged in having the whole Defence Force X-rayed. *By means of a large series of X-ray examinations, our whole army passes before the Röntgen screen.* This measure has already been carried into effect in large garrisons and in the smaller ones, where complete technical resources are, of course, not yet available, it is being undertaken by means of portable X-ray apparatus. Every man is subjected to the closest scrutiny. If anything appears at all suspicious, we take a *radiogram*. The importance of medical inspection in this form becomes obvious when it is realized that by this means unmistakable *tuberculosis* has been detected in men who felt perfectly well and were considered perfectly sound. They were immediately sent to the sanatorium at *Wünsdorf.* It would, of course, be an ideal arrangement if everybody could be placed once before the Röntgen screen, but, unfortunately, that is not possible while the process is so costly. We are determined, however, to enforce this measure throughout our army."

Sight-testing is of special importance.—The examination of young men who have reported for military service is carried a step further. The staff surgeon starts by testing their sight. "Good eyesight is of the utmost importance in the army. Defective sight can lead to the most disastrous results. For instance, in foggy weather, it is not easy to recognize night signals with tracer bullets. If a man confuses yellow and green, or blue, and, consequently, the range of the guns is increased instead of being shortened, we shall be firing on our own troops."

One of the young men is *slightly colour blind.* He is immediately rejected without any further examination.

"As far as we are concerned, a man who cannot distinguish colours might as well be blind. In such cases we are adamant."

Acuteness of vision and capacity for seeing in the dark and at great distances are tested before a man's hearing and other organs are examined.

In the midst of all these activities, the telephone bell keeps on ringing; a serjeant-major wishes to trace a man; a sick report is being put through, another one is wanted, etc.

The staff surgeon opens the medicine cupboard. Quite at the back of the shelf there is a small bottle of castor oil. We keep it in our cupboard to complete our store of medicines, but nowadays it does not deserve the reputation it enjoys. *We make hardly any use of castor oil and aspirin.* Nor have we any malingerers. On the contrary, we impress upon our men that it is better to report themselves sick too often than not often enough. If their complaint is not serious we send them back to duty. Nearly every day someone says to me: "There is nothing wrong, sir, but I thought I would like to show you this. . . and then they are so pleased when they are allowed to report for duty."

One case appears to be rather more complicated: "It will be better to send the man to a specialist," says the staff surgeon to his medical orderly. A card is filled in and the man told to report to the garrison hospital for examination.

The Garrison Hospital.—The garrison Lazarett of the III Wehrkreis (Div. Mil. District) in the Tempelhof is a small general hospital in itself with complete medical equipment. The senior medical officer makes his rounds through the various wards installed in separate houses. The rooms where the patients receive their treatment are bright and airy; pictures hang on the walls; everywhere the Sisters have decorated the curtains with bright ribbons; flowers and plants are dotted here and there; the food is cooking in large saucepans and legs of mutton are sizzling in the oven. Over three hundred men receive treatment.

Six Cradles.—Into one of the buildings the senior medical officer goes on tip-toe, opens a door gently and cautiously enters with a smile on his face. Six cradles stand along the wall. A baby, two hours old, lies in a small basket, in another there is one about two days old. "Only two little mortals?" queries the M.O. "Sometimes the whole ward is lined with them!"

Medical care for the dependants of members of the Army must, of course, include midwifery. The head nurse takes the little creature into her arms and rocks it gently to and fro. "The woman in room 3," she explains. In front of room 3 a vase full of bright flowers stands on the floor.

Cleaning a pistol.—As in every other hospital, the garrison hospital has *a casualty ward.* Thick drops of blood at the entrance lead us to the room. The senior medical officer follows the trail. Inside is a man—a chauffeur or a mechanic, judging by his appearance. The large hand, soiled with oil, is covered with blood. Bits of flesh hang from the thumb.

"Well," says the senior medical officer to the civilian, "what have you been up to?"

"I was cleaning a pistol, sir, *but there was still one cartridge in it.* It is nothing." The senior medical officer shakes his head and mutters to himself: "Queer times! I should like to see the man who, to-day, cleans a pistol in which there is not one more cartridge . . ." M. M.

Reviews.

AN ATLAS OF SKIN DISEASES IN THE TROPICS. By E. C. Smith, B.A., M.D.Dublin, D.P.H., D.T.M. and H.Eng. London: John Bale, Sons and Danielsson, Ltd. 1932. Pp. x + 60. 100 plates. 21s. net.

When the dermatologist proceeds to the tropics he enters a new clinical world. His preconceived ideas of skin lesions have to undergo a profound change. He sees for the first time many new forms of disease and many new varieties of old forms. The most important difference perhaps is that of colour. The subtle distinctions of the various shades of red, rose and pink, are completely absent in the lesions of a darkly pigmented skin. The picture becomes almost entirely a study in "black and white."

It is therefore interesting to discover a book illustrating in a comprehensive manner so many different aspects of this very difficult problem.

"An Atlas of Skin Diseases in the Tropics" is a concise, compact volume, clearly printed and profusely illustrated, and of a size which should not embarrass the traveller's kit.

Although written primarily for the West Coast of Africa this work has a far wider application and embraces most of the dermatological conditions of the tropics.

It is divided into two parts, descriptive and illustrative. The former gives a short account of the clinical appearance and treatment of each disease. The latter contains one hundred pictures in "black and white," which are well selected and beautifully reproduced; the detail is extraordinarily clear.

In a work which is intended as an atlas rather than a textbook, it is perhaps unfair to criticize the descriptive section. The chief comment is that it is somewhat unbalanced. It tends to be overweighted as regards pathology and underweighted as regards treatment. The average practitioner in the tropics is more concerned with the cure of his case than the histological appearance of its lesions. Admitting fully the advisability of microscopic investigation in certain instances, one would have thought that the practitioner in the bush or jungle would have little chance of employing such pathological refinements. These descriptions, excellent as they are, are more suited to the larger textbook.

Under the treatment of tinea cruris no mention is made of the importance of sterilizing the patient's underclothing, an omission which will usually lead to a relapse. The dhobie's stonebreaking efforts on a hard rock may shorten the life of our garments, but not that of such highly resistant organisms as cause tinea cruris.

Under syphilis the author states that the Wassermann test is regarded as a criterion of the disease in European clinics, but not amongst natives, "since a positive Wassermann (or its substitute, the Kahn) is the rule rather than the exception." Surely if both these valuable tests are positive the condition must be syphilis, active or latent, or its first cousin, yaws. In future editions this interesting point might be cleared up. Dark-ground diagnosis is rightly emphasized, but no course of treatment is laid down.

An interesting experiment is recorded showing that prickly heat can be artificially reproduced on a normal skin by an application of lint soaked in a broth-culture of the isolated monilia and retained for a period varying from five to twelve days. In some parts of the tropics, e.g., Lower Burma, the heat and humidity beneath soaked lint would be quite sufficient to produce in a very short time an intense eruption of prickly heat, apart altogether from the presence of artificially encouraged monilia. In April and May in Rangoon it will occur under the simplest of dressings on the hardest of skins.

The illustrations provide a complete pictorial key to diagnosis and

should prove extremely helpful to the new-comer to the tropics and a useful reference to those long resident. The atlas should certainly be included in the travelling library of every practitioner proceeding to West Africa.

L. B. C.

CRAIG'S POSOLOGICAL TABLES (Sixth Edition). Revised by D. M. Macdonald, M.D., D.P.H., F.R.C.P.E. Edinburgh: E. and S. Livingstone. 1933. Pp. 124. Price 2s.

The new edition of this well-known vade-mecum will be found especially useful as, in addition to the list of drugs with their doses in Imperial and metric weights and measures, their actions, and form of administration, there are included lists of the substances added to, and those omitted from, the 1932 Pharmacopœia. The changes in name, dosage and strength of various drugs in the new Pharmacopœia are also given.

In the appendices there are tables of weights and measures, lists of incompatibles, poisons with their tests and antidotes, diseases with their usual remedies, and the principal medicines arranged according to their actions.

The author recommends the book for the use of students, but many others will find it a handy guide, and the notes on the changes in the 1932 Pharmacopœia make it especially valuable.

A SHORT HISTORY OF DENTISTRY. By Lilian Lindsay, L.D.S.Edin. London: John Bale, Sons and Danielsson, Ltd. 1933. Pp. 88. Price 3s. 6d.

A history of one's calling holds a fascination but a degree removed from that of the family, and Mrs. Lindsay, in this small book, has collected so much data and told the story of dentistry with such remarkable talent that it cannot fail to appeal to all practitioners and students of dental surgery and to all who are interested in the history of medicine. In the frequent absence of the written word it is fortunate that the teeth, being the hardest and most lasting of all organs, are able to help in the telling of their own story, and even if original descriptions did exist of the binding together with gold wire of teeth affected by pyorrhœa and of the bridge work and prosthetic work practised by the Etruscans and by the ancients in the East Indies, they could scarcely have the same value as the examination of the actual excavated specimens. Mrs. Lindsay conducts us skilfully through the ages; we learn by the inscriptions on bricks, about 3000 B.C., of the almost modern conception of pyorrhœa by the Babylonians; we are informed that, although palliative measures were apparently undertaken for toothache, no instance of practical work in the mouths of the ancient Egyptians has yet been discovered, and the popular illusion that dentistry of a high standard was practised by these people is consequently shattered; we are in fact told of the conception of dental defects among most of the ancient races, and everywhere we find the story of absorbing interest. A

work of this nature necessarily contains references to charlatanism in the art which was particularly rife in the sixteenth century, and the indignation of that famous tooth-drawer Kindhart, who, the author suggests, was Henry Chettle, concerning this type of practice, is fully recorded. One of the most interesting sections of the book deals with the "uplift" of the profession in the nineteenth century, and from the trend of events it seems unfortunate that an amendment of the Medical Act to provide registration of dental licentiates under the Act was successfully opposed by non-medical dentists in 1859.

Mention is made of the formation of permanent Naval and Air Force Dental Services but none is made of The Army Dental Corps, a service which deals systematically with all troops, and which, in addition to the performance of other dental operations and prosthesis, conserves for "other ranks" alone over a quarter of a million teeth a year.

MATERIA MEDICA.—Catechism Series. Revised by D. M. MacDonald, M.D., D.P.H., F.R.C.P.E. Edinburgh: E. and S. Livingstone, 1932. Pp. 80 each part. Price 1s. 6d. each.

The acquirement of a working knowledge of drugs, their actions, uses and dosage, by a process of pure memorizing is a bugbear to every student of medicine and any work which will lighten the burden is to be welcomed.

In this series of small books, appearing in three parts, the subject is dealt with in the form of question and answer. Volumes I and II deal with the organic and inorganic preparations. Volume III is devoted to the official preparations and contains a lengthy list of good and useful prescriptions with the indications for their use. The series will be found useful to both students and practitioners. The volumes occupy little space and can easily be carried in a medical despatch case. J. H-S.

INJECTION TREATMENT IN MEDICAL PRACTICE.—By David Levi, M.S., F.R.C.S.Eng. London: Cassell & Co., Ltd., 1932. Pp. viii. + 150. 6s. net.

In the compass of a small volume Dr. Levi has described the technique of the remedial and diagnostic injection measures most of which may rightly be performed by the physician. The book is written in a pleasing and direct style with exact instructions which are easy to understand and follow.

A practitioner without previous experience could with the help of this book undertake such measures as injection for rectal prolapse or for varicose veins, the operation of cisterna puncture and intratracheal lipiodol injection, etc.

On the more dangerous ground of alcoholic injections of nerves and ganglia we hope no enthusiasts will be tempted by Dr. Levi's concise instructions to undertake against their better judgment measures which are only safe in the hands of expert surgeons and neurologists. Indeed, the

only criticism we have to offer of this excellent little book is that the procedures of Gasserian ganglion and fifth-nerve injections would perhaps have been more safely omitted altogether. Apparatus required is well and clearly described, and there are several useful illustrations where such are necessary to elucidate the text.

The book will be welcomed by Army medical officers. J. H-S.

DISEASES OF THE HEART: DESCRIBED FOR PRACTITIONERS AND STUDENTS. By Sir Thomas Lewis, C.B.E., F.R.S., M.D., D.Sc., LL.D., F.R.C.P. London: Macmillan and Co., Ltd. 1933. Pp. xx + 297. Price 12s. 6d. net.

There are few of us who are not familiar with Sir Thomas Lewis's writings; from our acquaintance with them we come to this, his most recent, with high expectations and are not disappointed. Its volume is small for such a vast subject, but as far as we can see, there is nothing omitted that the practitioner or student should know or would find useful.

Besides descriptions of the usual cardiac conditions, chapters are devoted to such subjects as Essential Hypertension, Arteriosclerosis, Child-bearing, Anæsthetics and Operations; all are treated in the simplest manner, that of the hospital teacher giving his students the results of his clinical experience.

The use of instrumental aids to diagnosis, such as the electrocardiograph, that are beyond the scope of the general practitioner, is not emphasized; stress is laid throughout on physical signs within the immediate reach of all. Directions for treatment are clear and adequate; prognosis is equally lucid.

We confidently recommend this excellent book. Besides being a master of his special subject, the author is a master of the art of writing; reading the book is a real pleasure.

Correspondence.

A GLIMPSE OF THE GENESIS OF QUEEN ALEXANDRA'S IMPERIAL MILITARY NURSING SERVICE.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—On looking over some old letters a few days ago I came across the following which I hope is sufficiently interesting to appear in the Journal.

The letter from which the extract is taken was written by Dr. Edward Newman, a surgeon in the Navy, and is headed:—

"H.M.S. TRAFALGAR, BEICOS BAY, 25TH DECEMBER, 1854.

"We had a visit yesterday on board of about 40 of these female nurses who patriotically gave up house and home and every comfort to attend on

the poor wounded soldiers and administer to the wants and little necessities of many poor fellows who have fallen for their country and which can only be done to perfection by female tenderness and care. They are all dressed in the same costume, a sort of uniform in its way and look very odd. Many of them are highly connected. They have only recently arrived and one of them told me in the most *formal way* that they are at present *waiting orders* and are uncertain whether they will be stationed at Scutari or go up to Balaklava. I had the high honour of showing them over the hospital of the ship, and being in the same line of trade with them I flatter myself that it was quite a case of 'birds of a feather flock together.' I doubt much their liking the profession they have adopted—the sight of such a ship was quite a treat to them, poor things. They remained on board for about half an hour when the Captain landed the 'female doctors' as he called them."

Headquarters, Northern Command,
York,
June 20, 1933.

I am, etc.,
W. J. E. BELL,
Lieut.-Col., R.A.M.C.

Notice.

TROPICAL HYGIENE.

THE BRITISH RED CROSS SOCIETY will hold a course of seven lectures and demonstrations on Tropical Hygiene, on Mondays, Wednesdays and Fridays, commencing on Friday, September 22, at 9, Chesham Street, Belgrave Square, S.W.1, at 5.30 p.m.

The course will cover such questions as food, clothing, and medical and sanitary precautions necessary for health in hot countries.

These lectures are open to non-members of the British Red Cross Society.

The examination for the British Red Cross Society's certificate in Tropical Hygiene will be held on Monday, October 9.

The fees for the course are 5s. for members of the Red Cross Society and 7s. 6d. for non-members.

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Gt. Britain Army

No. 3. September, 1933. Vol. LXI.

Journal

OF THE Royal Army Medical Corps

ISSUED MONTHLY

EDITOR.
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JOHN BALE, SONS & DANIELSSON, Ltd.
83-91, GREAT TITCHFIELD STREET, LONDON, W.1

Price Two Shillings net

VOL. LXI. SEPTEMBER, 1933. No. 3

Journal
of the
Royal Army Medical Corps.

Original Communications.

NOTES ON THE CHLORAMINE TREATMENT OF WATER.

By MAJOR S. ELLIOTT, B.Sc., F.I.C., F.C.S.,
Analyst, Royal Army Medical College.

(1) HISTORICAL SURVEY.

As far back as 1907 a German chemist, Rachig [1] described chloramines and gave a method for their preparation. This was regarded as a piece of academic research and was not put to any practical use. Three years later Rideal [2] tried to purify sewage by treatment with chlorine, and found that after the whole of the chlorine had disappeared, a germicidal action continued. He knew that the sewage contained ammonia and so he ascribed the action to the formation of chloramine. In America, Race [3] experimented in 1915 on the treatment of water supplies with chloramine made by mixing two parts of chlorine to one part of ammonia in solutions not stronger than 5,000 parts per million. He found that this substance, unlike chlorine, persisted in the water, and that it had a powerful sterilizing effect quite equal to chlorine. So efficient was the substance that it reduced the organisms to between 10 and 0·3 per cent of the numbers originally present in the water. He then tried it on a large scale with the Ottawa supply where he used a mixture of chlorine solution 0·3 to 0·6 per cent and ammonia solution of about equal strength, and in his book [4] he stated that good results were obtained. For some reason or other, the matter was not pursued further, until in 1924 Harold and Ward [5] reported on their experimental work at the Army School of Hygiene, Aldershot, and after that many observers commenced investigations and published their results. Harold and Ward [5A] working

entirely with the Army water-cart, prepared their chloramine by mixing in a kettle ammonium bicarbonate and chlorine water. This chloramine they then added to the bulk of the water to be sterilized. The chlorine water they prepared by charging water in a Sparklet syphon with compressed chlorine gas. They claimed that chloramine persisted in dirty water and retained its germicidal activity, that it had less taste than chlorine and that it was a vast improvement on chlorine for the treatment of water supplies.

In 1926, Adams [6] reported on some experimental work on waters from wells in the chalk, using small doses of chlorine with various proportions of ammonia acting for several hours. He found that if the concentration of the mixture was over ten parts per million using bleaching powder or 1,000 parts per million when chlorine gas was used, there was a considerable loss of available chlorine, and therefore a loss of germicidal power. He also found that ammonia was more effective as a taste preventer than the salts of ammonia, and that there was also less taste with chloramine made according to Harold and Ward's method than when chlorine and ammonia were mixed in the bulk of the water. His results, however, showed that there was practically no difference in sterilizing activity between chloramine made by Harold and Ward's method and that made in the bulk of the water.

In 1928, Harold [7] advocated the use of preformed chloramine, prepared as in his 1924 experiments, and noted that dirty water destroyed chloramine to a slight extent. In the same year some experiments on the treatment of swimming-bath water [8] were published, chloramine again proving superior to chlorine and not being destroyed by tropical sunlight. It was found that a concentration as high as two parts per million was quite unnoticeable, but it was decidedly slower than chlorine in its sterilizing action. Methods were also given for the determination of chlorine and chloramine in the presence of each other.

The germicidal effect on cercariæ in Egypt was reported upon by Griffiths-Jones, Atkinson and Hassan in 1930 [9]. They found that chloramine prepared in greater concentrations than 25 parts per million before addition to the water was not stable. They concluded that one part of chloramine in tap-water or two parts per million in the raw water of the River Nile, in ratios of two parts of chlorine to one of ammonia, killed cercariæ in one hour.

In 1932, Berliner [10] described the preparation and properties of strong solutions of chloramine and referred to some work done by Chapin in 1929 [11]. The latter found that mixtures of chlorine and ammonia in very acid solutions (pH 4·4) yielded nitrogen trichloride, in less acid solutions (pH 5·0 to 8·5) mixtures of mono- and di-chloramines were found, and in alkaline solutions (pH over 8·5) mono-chloramine was produced.

The Annual Reports of the Metropolitan Water Board for the last few years give records of the use of small doses of chloramine acting for

long periods. The results show very efficient sterilization and no troubles due to taste.

Chloramines are chlorine compounds of ammonia (NH_3) in which one or two of the hydrogen atoms are substituted by chlorine forming respectively mono-chloramine (NH_2Cl) and di-chloramine ($NHCl_2$).

Further substitution produces nitrogen trichloride (NCl_3), a dangerously explosive chemical. In concentrated solutions they all decompose to nitrogen, ammonium chloride and other products.

Experimental work has recently been carried out at the Royal Army Medical College on the preparation and properties of chloramines in order to fill in gaps in the present knowledge of these substances, and to make clear the treatment of water with them to officers of the Corps who have not the necessary time and opportunity to study the question beforehand.

(2) The Preparation of Chloramine.

Materials Required.—(*a*) Ammonia. Ammonia gas from cylinders may be used and introduced into the water through suitable apparatus. Care must be taken to keep the ammonia gas away from the chlorine gas or bleach until they are mixed in dilute solution, on account of the risk of forming the dangerously explosive compound, nitrogen trichloride.

Ammonia solution (specific gravity 0·880) may be used, but it is inconvenient to handle on account of its pungent odour.

The salts of ammonia, the chloride or sulphate, are the most convenient for portable plants, store well if kept dry and can be made into tablets if required. They do not evolve any fumes of ammonia and if dry are non-corrosive. The bicarbonate has been used, but evolves fumes of ammonia and its composition is apt to alter. The chloride contains one third of its weight of ammonia and the sulphate one quarter, and both can be obtained almost anywhere, the chloride being ordinary sal-ammoniac and sulphate being used as a fertilizer.

All these sources of ammonia are equally efficient as shown by Tables I and IA and by Harold and Ward's results. Most waters are sufficiently alkaline to liberate ammonia from its salts or the dilution is so great that the salts are ionized thus ensuring that free ammonia is present in the water.

(*b*) Chlorine. Chlorine gas from cylinders may be introduced into the water through apparatus similar to that used for ammonia gas, but as the cylinders and apparatus are heavy, this system is better suited for large installations than for portable plants.

Bleaching powder, water-sterilizing powder, tropical bleach and "chlorosene" are all easily transportable and, with the exception of bleaching powder, are stable in good storage. They are all effective as vehicles for chlorine provided the percentage of available chlorine is known and remains reasonably high. This must of course be previously estimated. The correct dose required is easily measured out by means of small spoons

or scoops, but as bleaching powder is lighter than the others, the scoop used for its measurement should be slightly larger. Unfortunately, these substances cannot be made into satisfactory tablets with or without binding materials, as the tablets disintegrate on storage.

Sodium hypochlorite solutions can be made by the electrolysis of salt solution (five per cent) between Acheson graphite electrodes with a current density of about one ampere per square inch of surface at four volts. So long as the temperature of the solution is kept below blood-heat all is well, but as the temperature rises above this, chlorate begins to be formed, and as it has no sterilizing power, it is useless for water purification. Hypochlorite made in this way is just as effective as the above forms of chlorine.

The Preparation.—Preformed chloramine is made by mixing the chlorine and ammonia solutions together and adding the mixture to the water to be treated.

Bulk-formed chloramine is made by adding the ammonia solution to the water to be treated, and when it has been distributed evenly, the chlorine solution is then added.

There are three things to be considered in the preparation of chloramine :—

(i) The weight of ammonia and chlorine to be used.

(ii) The concentration of the solutions of ammonia and chlorine before mixing.

(3) THE METHOD OF MIXING.

(i) *The Weight of Ammonia and Chlorine to be used.*

In Tables I, IA, IB, II, IIA and IIB it will be seen that the best ratio of weights to use in order to form chloramine practically free from chlorine is four or less parts of chlorine to one part of ammonia. If the ratio of chlorine rises to six parts, then a considerable part exists as free chlorine and is subject to destruction by dirt in the ordinary way. With higher ratios of chlorine, an even larger proportion exists as free chlorine. On the other hand, a low ratio of chlorine forms a slower acting type of chloramine, as shown in Tables III, IIIA, IVA, IVB, etc.

The ratio of four parts of chlorine to one part of ammonia by weight gives a quick-acting product free from serious deviation. It is very rare for a natural water to contain sufficient ammonia to upset these ratios, so the ammonia in the water may normally be neglected.

(ii) *The Concentrations of the Solutions before Mixing.*

In the case of "bulk-formed" chloramine the concentrations of the ammonia and of the chlorine solutions do not matter, of course, as they will be diluted down to one or two parts or less per million before they are mixed. It was found that the concentration of the chlorine solution which is added to the water already containing the ammonia had no effect on the amount of chloramine formed; a strong solution formed the same relative proportion of chloramine as a weak one.

On the other hand, if "preformed" chloramine is to be used, then the strengths of the ammonia and chlorine solutions are of vital importance. In the remarks on Table II it will be seen that a delay of five minutes after mixing and before adding the mixture to the water, in the case of a concentration of 25 parts per million, was of little consequence. In Table IIA when the concentration was 100 parts per million a five minutes delay caused a considerable loss of chlorine, and in Table IIB where 1,000 parts per million were used nearly all the chlorine disappeared in five minutes. Hence it is necessary when using this method of making chloramine to use concentrations of ammonia and chlorine of less than 25 parts per million, or else if stronger solutions are to be used the addition to the water must be made immediately after mixing. In designing apparatus care must be taken to see that no dead spaces exist where the mixture can stand for any length of time before addition to the bulk of the water.

(iii) *The Method of Mixing.*

Bulk-formed Chloramine.—The only precautions necessary are that the ammonia should be dissolved and then evenly distributed before the chlorine is added, and that the ammonia should be added before the chlorine. Raw Thames water at Millbank containing about one part per million of free and saline ammonia destroyed 0·4 part per million of free chlorine in five seconds. When ammonium sulphate was added first the destruction was not so serious; compare the "initial concentrations" in Table V where the same quantity of chlorine solution was added to tap-water, and to raw and filtered Thames water.

Preformed Chloramine.—The precautions to be taken are only those in connection with the concentrations of the solutions of ammonia and chlorine as pointed out above. No differences were obtained between mixtures in which the chlorine was added to the ammonia, or the latter added to the former.

The problem arises—which of these two methods of mixing should be chosen?

As will be seen from Tables IIIA and IIIB, preformed chloramine has an advantage in cases where doses of less than about three-quarters of a part of chloramine per million is used in that it appears to have a more rapid sterilizing action than the bulk-formed type. The mechanical difficulties of making preformed chloramine in a main can be easily overcome by inserting a small bore mixing pipe in the water main. For Army purposes, however, where doses of one or more parts per million are used, the bulk-formed chloramine is simpler to make and is equally effective, as is shown in Tables IV, IVA, etc. Chloramine made by the preformed method, especially when the ratio of ammonia is high, contains a substance which gives what Major Harold terms "a second fraction." In the ordinary determination of chloramine, potassium or other iodide and starch are added to the water containing the chloramine. A blue colour is formed and the

addition of sodium thiosulphate in quantities just sufficient to discharge the blue colour can be made to give the strength of chloramine in the water. The colour having been discharged, if acid is now added to the water a blue colour again appears and once more sodium thiosulphate will decolorize it. This is called the "second fraction" and Major Harold indicated it in water by placing a plus sign after the first fraction and then inserted the amount of the second fraction; thus 1·0 + 0·5 part per million. In bulk-formed chloramine the second fraction very seldom occurs and then only in very small amounts.

Efforts were made to ascertain the nature of this second fraction but without success. It disappears, like chlorine, entirely from water after one hour's incubation at 70° C. It persists in water at 15° C. even after the ordinary chloramine (first fraction) has disappeared. It responds to tests for small amounts of nitrites (Griess Ilosvay) but not in sufficient amount to account for it all. It gives negative reactions to tests for peroxides, hydrazine, hydroxylamine, hyponitrous acid and nitrogen trichloride.

(4) The Properties of Chloramine.

(*a*) Sterilizing action: *B. coli*. The results in Tables III, IIIA, IIIB and IIIC show that chloramine will kill *B. coli* in one part per million river water and in filtered mixtures of sewage and water, both of which contained the naturally occurring organism, also in tap-water inoculated with organisms from a laboratory culture.

Organisms of Water-borne Diseases.—The results in Tables IV, IVA, IVB, IVC and IVD show that chloramine will kill the organisms of water-borne diseases in clear water. Laboratory cultures of resistant strains were used as they were more easily obtainable and more resistant to the action of disinfectants than the naturally occurring organisms.

These results show that chloramine is not so rapid in its action as chlorine, taking with equal doses about twice as long, that a 4 : 1 ratio is more rapid than a 3 : 1 or 2 : 1 ratio, and that there is little difference between preformed and bulk-formed chloramine except in very small doses. As shown in Table IIIB chloramine like most other disinfectants is more active as a germicide at blood-heat than at lower temperatures, and as it resists a certain degree of heating its action in the tropics is better than in temperate climates.

Other Organisms.—Chloramine will not kill all organisms, for, as shown in Tables VI and VII, Thames water contains an organism very resistant to chloramine. The Pathological Department at the Royal Army Medical College reported that the organism was not pathogenic.

(*b*) Penetration: The penetrative power of chloramine does not appear to be any greater than that of chlorine and a considerable time is taken to sterilize raw water containing organisms enclosed in pieces of insoluble material.

Table VI shows this effect on filtered and unfiltered Thames water

where two parts per million failed to sterilize unfiltered water in two hours but sterilized the filtered water in one hour. One experiment showed that it took about three days to sterilize the raw water. As the concentration of chloramine remained unimpaired, this action is obviously due to lack of penetration.

These results indicate that it is always necessary to filter water in addition to treatment with chloramine if the water is required quickly.

(*c*) Taste: To the average person water containing two parts per million of chloramine has no taste. Tea containing two parts per million has no unusual flavour. Water containing three parts per million has a slight taste which becomes quite definite when the dose is increased to four parts per million.

Preformed chloramine, made from 1 in 1,000 solutions of sodium hypochlorite and ammonium sulphate and added to water in a strength of one part per million, gives a distinct taste, but preformed chloramine made from weaker solutions is tasteless.

(*d*) Persistence: In clean water, chloramine persists for days; for example, London tap-water, treated with 2·4 parts of chloramine per million, contained 2·3 parts seven days later.

In contaminated water, chloramine is destroyed to a small extent; for example in filtered water from the River Stour at Blandford the concentration fell in two hours from 2 parts per million to 1·8. Six hours later, however, the water still contained 1·8 parts per million, a loss of ten per cent. In Table V it will be seen that chloramine is destroyed to the extent of about ten per cent fairly rapidly and thereafter it loses strength very much more slowly. The suspended matter, it will be noted in this table, does not appear to deviate chloramine to any great extent.

(5) Methods of Introducing Chloramine into Water Supplies.

(*a*) The Metropolitan Water Board, the Army authorities at Catterick and other water authorities introduce a small dose of ammonium sulphate solution or of ammonia gas into the water after filtration by means of a Paterson or Wallace Tiernan apparatus as the water flows through the main. The amount generally used is of the order of one-tenth to one-quarter of a part per million. After a short run through the main, which allows the ammonia to become diffused evenly through the water, chlorine is introduced as gas by means of similar apparatus to the above, usually in the proportion of twice the amount of ammonia added. As dirt does not destroy chloramine to any serious extent, the substance may be added before filtration and the filters are thus kept more or less sterile, or at any rate organisms will not multiply in them.

It is the usual practice to add the ammonia first as it prevents the destruction of the chlorine by dirt in the water. If the chlorine is added first to contaminated water, a certain amount will be destroyed and

either the dose will be too low for efficient sterilization or the dose must be raised and chlorine will be wasted.

(*b*) In the Elliott Mobile Water purifier for the purification of water, a weak solution of ammonium sulphate is fed at a constant rate into the water as it flows through the intake pipe. The proportion generally used is about half a part of ammonia per million. A little further along the intake pipe, chlorine in the form of a solution of salt which after electrolysis contains sodium hypochlorite, is added usually in the proportion of about two parts per million but the doses in both cases may be varied.

The dose of chloramine in the water is higher than that used for large installations because the water is required almost immediately, whereas in the large installations the water is stored in the reservoirs and mains for some time, thus allowing a sufficient period of contact for the chloramine to sterilize the water. Small doses require a longer period of contact for sterilization than larger doses.

(*c*) In the new method proposed by Major F. McKibbin, R.A.M.C., for the Army water-cart, bulk-formed chloramine is used. Two tablets (five grains each) of ammonium chloride are added to the water in the cart when about one-quarter full, and when about half full, two scoopfuls (about sixty grains) of "tropical bleach," previously mixed into an emulsion with water. The movement of the water during the filling process mixes the contents of the cart and distributes the chloramine evenly.

The dose of chloramine amounts to between 1½ and 2 parts per million, the ammonia being added first.

The official Water Sterilizing Powder may be used instead of tropical bleach (*proprietary name Chlorosene*) provided allowance is made for any difference in chlorine content.

(*d*) For the treatment of swimming-bath water with chloramine no data are available except those mentioned in the experiments in reference [8] and the pamphlet "The Purification of the Water of Swimming Baths," issued by the Ministry of Health, in which reference is made to Race's work. The Plumstead Baths at Woolwich are now using chloramine.

(6) Details of Experimental Work.

The objects of the experimental work were to investigate: (i) the chemistry of chloramines and their formation, (ii) the bacteriological properties of chloramines, (iii) the chemical and bacteriological properties of chloramine in contact with the dirtiest water available.

The results of the investigations are given in the tables printed at the end of this paper :—

(i) Tables I and II.

The actual practical details of the work are included in each table for the sake of simplicity. It was found that incubation at 60° C. for one hour destroyed free chlorine while chloramine deteriorated to an extent of only 20 per cent. Moreover, it was found that chlorine in as low a

concentration as 0·2 to 0·3 part per million bleaches a dilute solution of methyl red in a few minutes, whereas chloramine in large concentrations does not do so. By combining these two facts it became feasible to analyse the substances produced and to find roughly what proportions of free chlorine and of chloramine existed in the mixture. By a further calculation the ratio of chlorine as chloramine to ammonia present could be roughly ascertained and a surmise of the kind of chloramine present, whether mono- or di-, could be deduced.

The lesson to be learnt from these series of tables is that there appears to be very little difference chemically between "preformed" and "bulk-formed" chloramine made according to certain directions given in the tables.

If two of these directions are not carefully observed the performed variety will be inferior to the bulk-formed type; firstly the concentrations of the solutions to be mixed together before addition to the water must certainly not exceed 100 parts per million, and secondly the mixture should not be preserved for any length of time before addition to the water. Otherwise the dose of chloramine will be below that anticipated.

These tables also show that chloramine made from ratios of chlorine to ammonia higher than 4 : 1 contain free chlorine which, of course, is capable of deviation in dirty water.

For the same amount of chlorine, the 4 : 1 ratio does not give so large a concentration of chloramine in the water as in the case of the 2 : 1 and 1 : 1 ratios. However, the 2 : 1 and 1 : 1 ratios are not recommended for Army use as the bacteriological results show that they are slower in their action than the 4 : 1 ratio.

Hence to obtain the most advantageous results, a ratio of four parts by weight of chlorine to one of ammonia is recommended.

(ii) Tables III and IV.

In the bacteriological tests, ratios of 4 : 1, 3 : 1 and 2 : 1 were used as higher ratios would include in addition to the chloramine, free chlorine which has been tested already.

The results show that as the proportion of ammonia rises the action becomes slower, that the best ratio for speed and non-deviation is 4 : 1 and that one part of chloramine per million is sufficient to render a water safe for drinking in from one to one and a half hours. *Vibrio choleræ* appears to be very susceptible to the action of chloramine, but *Bact. paratyphosum* A and B are not so easily killed. The dose of 1½ to 2 parts per million given in the method for the water-cart proposed by Major McKibbin should render the water safe for drinking in an hour.

(iii) Tables V, VI and VII.

With dirty water chloramine is deviated to a small extent, but one part of chloramine (ratio 4 : 1) will kill in from one to one and a half hours typhoid bacilli in raw water which has been filtered. If the water has not been

filtered there is a risk that chloramine will not penetrate through particulate matter sufficiently rapidly to kill organisms in the interior, hence filtration or sedimentation in addition to chloramination is recommended.

SUMMARY.

(1) Mixtures of ammonia and chlorine have properties differing from free chlorine, and the compounds produced are commonly known as chloramine.

(2) Chloramine should be prepared for Army purposes by mixing chlorine or its compounds with ammonia or its salts in the proportion by weight of 4 : 1.

(3) The dose of chloramine recommended to sterilize water in one hour for Service purposes is between one and two parts per million.

(4) So long as chloramine is prepared correctly and the dose is not allowed to exceed two parts per million, no taste troubles should occur.

(5) Owing to its relatively slow powers of penetration, it is essential that water should be filtered in addition to its being treated with chloramine.

In conclusion I wish to thank the Staff of the Hygiene and Pathological Departments of the Royal Army Medical College for their help with this work.

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TABLE I.—CHEMICAL RESULTS BULK-FORMED CHLORAMINE.

Ammonium chloride in the requisite proportion was mixed with one quarter of the water to be sterilized. After addition of a further quarter of the water the requisite amount of "chlorosene" emulsion was added. The remaining half of the water was then mixed in.

Part (355 millilitres) was titrated to check the initial strength, another 50 millilitres were tested with a drop of 1 in 1,000 methyl red in N/10 soda to see if free chlorine was present, and the rest was incubated at 60° C. for one hour. After cooling, 355 millilitres were titrated and 50 millilitres tested for bleaching by free chlorine with methyl red ; chloramine did not bleach.

PARTS PER MILLION.

Ratio Cl NH$_3$	Initial concentration	Methyl-red test	Final concentration	Methyl-red test	Loss	Loss per cent approx.
10 : 1	1·6	Bleached	0·15	Unbleached	1·45	90
8 : 1	1·6	,,	0·40	,,	1·20	75
6 : 1	1 6	,,	0·65	,,	0·95	60
4 : 1	1·9	Unbleached	1·30	,,	0·60	32
2 : 1	2·2	,,	1·50	,,	0·70	31
1 : 1	2·2	,,	2·20	,,	0·00	*Nil*

ANALYSIS OF TABLE I.

The amount of chloramine present in this case is calculated by adding thirty per cent to the final concentration to allow for the loss on heating; the free chlorine concentration is the difference between the initial concentration and the amount of chloramine found. The ammonia is known from the amount already present and added, and the ratio combined chlorine to ammonia is the ratio of chlorine present as chloramine to ammonia; with a 2 : 1 ratio the product is reckoned as mono-chloramine (NH_2Cl) and with 4 : 1 di-chloramine ($NHCl_2$).

PARTS PER MILLION.

Ratio Cl NH$_3$	Chloramine present	Chlorine present	Ammonia present	* Ratio	Product
10 : 1	0·20	1·40	0·20	1 : 1	?
8 : 1	0·50	1·10	0·25	2 : 1	NH_2Cl
6 : 1	0·80	0·80	0·33	2·40 : 1	Mixture
4 : 1	1·70	0·20	0·50	3·40 : 1	Mixture
2 : 1	1·95	0·25	1·00	1·95 : 1	NH_2Cl
1 : 1	2·80	—	2·00	1 : 1	—

* Combined chlorine : ammonia by weight.

IA. *Ammonium sulphate* was used instead of ammonium chloride, and exactly the same procedure as in the previous table was carried out.

Ratio Cl NH$_3$	Initial concentration	Methyl-red test	Final concentration	Methyl-red test	Loss	Loss per cent approx.
10 : 1	2·00 + 0·005	Bleached	0·20 + 0·0	Unbleached	1·80	90
8 : 1	1·85 + 0·15	,,	0·35 + 0·0	,,	1·50	80
6 : 1	2·15 + 0 05	,,	0·65 + 0·0	,,	1·50	70
4 : 1	2·20 + 0·00	Unbleached	1·60 + 0·0	,,	0·60	27
2 : 1	2·25 + 0·00	,,	1·80 + 0·0	,,	0·45	20
1 : 1	2·25 + 0·00	,,	1·80 + 0·0	,,	0·45	20

ANALYSIS OF IA.

Ratio Cl NH$_3$	Chloramine present	Chlorine present	Ammonia present	Ratio	Product
10 : 1	0·25	1·75	0·20	1·25 : 1	?
8 : 1	0·40	1·45	0·25	1·60 : 1	NH_2Cl
6 : 1	0·80	1·35	0·33	3·00 : 1	Mixture
4 : 1	1·90	0·30	0·50	3·80 : 1	Mixture
2 : 1	2·15	0·10	1·00	2·15 : 1	NH_2Cl
1 : 1	2·15	0·10	2·00	1·07 : 1	—

To compensate for the loss on incubation, twenty per cent was added to the chloramine.

IB. *Ammonium sulphate* and *chlorine water* 1 in 1,000 prepared from permanganate and hydrochloric acid and passed through solid bleaching powder. Procedure as before.

Ratio Cl NH_3	Initial concentration	Methyl-red test	Final concentration	Methyl-red test	Loss	Loss per cent approx.
10 : 1	1·80 + 0·30	Bleached	*Nil*	Unbleached	1·80	100
8 : 1	1·80 + 0·30	,,	0.25 + 0·0	,,	1·55	86
6 : 1	2·05 + 0·15	,,	0·70 + 0·0	,,	1·35	65
4 : 1	2·20 + 0·10	,,	1·65 + 0·0	,,	0·55	25
2 : 1	2·20 + 0·10	Unbleached	1·85 + 0·0	,,	0·35	16
1 : 1	2·30 + 0·05	,,	1.90 + 0·0	,,	0·40	17

ANALYSIS OF IB.

Ratio	Chloramine present	Chlorine present	Ammonia present	Ratio	Product
10 : 1	*Nil*	1·8	0·20	*Nil* : 0·2	—
8 : 1	0·30	1·5	0·25	1·20 : 1	—
6 : 1	0·85	1·2	0·33	2·60 : 1	Mixture
4 : 1	2·00	0·2	0·50	4·00 : 1	$NHCl_2$
2 : 1	2·20	*Nil*	1·00	2·20 : 1	NH_2Cl
1 : 1	2·30	*Nil*	2·50	1·15 : 1	—

Compensation figure twenty per cent.

TABLE II.—CHEMICAL RESULTS PREFORMED CHLORAMINE.

Ammonium sulphate 25 *parts per million* and *chlorine gas solution* 25 *parts per million* mixed in the requisite proportions and stirred into the bulk of the water. The rest of the procedure as before.

Ratio Cl NH_3	Initial concentration	Methyl-red test	Final concentration	Methyl-red test	Loss	Loss per cent approx.
10 : 1	1·70 + 0·25	Unbleached	*Nil*	Unbleached	1·70	100
8 : 1	1·70 + 0·25	,,	0·15 + 0·0	,,	1·55	90
6 : 1	1·70 + 0·30	,,	0·55 + 0·0	,,	1·15	70
4 : 1	1·85 + 0·20	,,	1·45 + 0·0	,,	0·40	20
2 : 1	2·00 + 0·00	,,	1·65 + 0·0	,,	0·53	16
1 : 1	2·10 + 0·00	,,	1·80 + 0·0	,,	0·30	14

ANALYSIS OF THE ABOVE.

Ratio Cl NH_3	Chloramine present	Chlorine present	Ammonia present	Ratio	Product
10 : 1	*Nil*	1·70	0·20	*Nil* : 0·2	—
8 : 1	0·18	1·52	0·25	0·72 : 1	—
6 : 1	0·65	1·05	0·33	1·95 : 1	NH_2Cl
4 : 1	1·75	0·10	0·50	3·50 : 1	Mixture
2 : 1	2·00	*Nil*	1·00	2·00 : 1	NH_2Cl
1 : 1	2·15	*Nil*	2·00	1·07 : 1	—

Loss of chlorine in the mixture on standing for five minutes before addition to the water. A 4 : 1 ratio mixture gave 1·85 + 0·2 parts per million after standing ten to fifteen seconds, but the same mixture after five minutes' standing before addition to the water gave a water containing 1·75 + 0·35 parts per million.

IIA. *Ammonium sulphate* 100 *parts per million* and *chlorine gas solution* 100 *parts per million* mixed in the requisite proportions and stirred into the bulk of the water. The rest of the procedure as before.

Ratio Cl NH_3	Initial concentration	Methyl-red test	Final concentration	Methyl-red test	Loss	Loss per cent approx.
10 : 1	1·40 + 0·30	Bleached	0·20 + 0·0	Unbleached	1·20	85
8 : 1	1·55 + 0·30	,,	0·40 + 0·0	,,	1·15	75
6 : 1	1·60 + 0·25	,,	0·90 + 0·0	,,	0·70	55
4 : 1	1·75 + 0·10	Unbleached	1·35 + 0·0	,,	0·40	20
2 : 1	1·75 + 0·10	,,	1·45 + 0·0	,,	0·30	15
1 : 1	1·75 + 0·20	,,	1·40 + 0·0	,,	0·35	20

ANALYSIS OF IIA.

Ratio Cl NH_3	Chloramine present	Chlorine present	Ammonia present	Ratio	Product
10 : 1	0·25	1·15	0·20	1·15 : 1	?
8 : 1	0·50	1·05	0·25	2·00 : 1	NH_2Cl
6 : 1	1·10	0·50	0·33	3·30 : 1	Mixture
4 : 1	1·60	0·15	0·50	3·20 : 1	Mixture
2 : 1	1·75	*Nil*	1·00	1·75 : 1	NH_2Cl
1 : 1	1·70	0·05	2·00	0·85 : 1	?

Loss of chlorine caused by delay in treating the water. A 4 : 1 ratio mixture gave a water with 1·75 + 0·1 parts per million after a ten seconds' delay, but a five minutes' delay gave a water containing 0·75 + 0·25 part per million.

IIB. *The same chemicals in a* 1,000 *parts per million dilution.*

Ratio	Initial concentration	Methyl-red test	Final concentration	Methyl-red test	Loss	Loss per cent approx.
10 : 1	0·8 + 0·15	Bleached	0·25 + 0·0	Unbleached	0·55	70
8 : 1	1·0 + 0·15	Unbleached	0·60 + 0·0	,,	0·40	40
6 : 1	1·0 + 0·15	,,	0·70 + 0·0	,,	0·30	30
4 : 1	1·0 + 0·20	,,	0·70 + 0·0	,,	0·30	30
2 : 1	1·0 + 0·20	,,	0·80 + 0·0	,,	0·20	20
1 : 1	0·6 + 0·20	Bleached	0·30 + 0·0	,,	0·30	50

The last result was anomalous because half a minute elapsed before the mixture was added to the water.

ANALYSIS OF IIB.

Ratio $Cl\ NH_3$	Chloramine present	Chlorine present	Ammonia present	Ratio	Product
10 : 1	0·30	0·50	0·20	1·50 : 1	--
8 : 1	0·70	0·30	0·25	2·80 : 1	Mixture
6 : 1	0·85	0·15	0·33	2·55 : 1	Mixture
4 : 1	0·85	0·15	0·50	1·70 : 1	NH_2Cl
2 : 1	0·95	0·05	1·00	0·95 : 1	—
1 : 1	0·35	0·25	2·00	—	—

Loss of chlorine caused by delay in treating the water. A ten to fifteen seconds' delay before addition of the mixture to the water gave 1·0 + 0·2 parts per million, but five minutes' delay gave a concentration 0·1 + 0·25 part per million in the water.

TABLE III.—BACTERIOLOGICAL RESULTS. *B. coli.*

London tap-water was inoculated with a normal saline emulsion of *B. coli* from an agar slope after twenty-four hours' incubation at 37° C. One millilitre out of a total ten millilitres of emulsion was added to every litre of tap water. For the preformed chloramine, chlorine gas solution 25 parts per million, and for the bulk-formed chlorosene emulsion was used; the source of ammonia was ammonium sulphate. The temperature throughout was 15° C. Fifty millilitre portions were inoculated at the requisite intervals into double strength MacConkey's medium. The control gave acid and gas (i.e., positive) in one millilitre.

Dose, 1 part per million.

	Preformed chloramine			Bulk-formed chloramine		
	4 : 1	3 : 1	2 : 1	4 : 1	3 : 1	2 : 1
Concentration at start ..	1·2 + 0·0	1·2 + 0·0	1·1 + 0·0	1·2 + 0·0	1·2 + 0·0	1·2 + 0·0
Methyl-red test	Un-bleached	Un-bleached	Un-bleached	Un-bleached	Un-bleached	Un-bleached
Concentration after 2 hours	1·0 + 0·0	1·15+0·0	1·10 +0·0	1·0 + 0·0	1·20+0·0	1·20+0·0
MacConkey's medium—						
½ hour contact	*Nil*	A.G.	A.G.	*Nil*	A.G.	A.G.
1 ,, ,,	,,	*Nil*	*Nil*	,,	*Nil*	*Nil*
1½ ,, ,,	,,	,,	,,	,,	,,	,,
2 ,, ,,	,,	,,	,,	,,	,,	,,

Result: 4 : 1 sterilization in half-an-hour, the remainder sterilization in one hour.

IIIA. As above, but with a dose of ¾ part per million. Control positive in one millilitre. No "second fractions."

The preformed variety is more effective than the bulk-formed variety at this concentration.

	Preformed			Bulk-formed		
	4 : 1	3 : 1	2 : 1	4 : 1	3 : 1	2 : 1
Concentration at start ..	0·75	0·75	0·75	0·70	0·75	0·75
Methyl-red test	Un-bleached	Un-bleached	Un-bleached	Un-bleached	Un-bleached	Un-bleached
Concentration after 2 hours	0·60	0·60	0·65	0·55	0·60	0·65
MacConkey's medium—						
½ hour contact	A.G.	A.G.	A.G.	A.G.	A.G.	A.G.
1 ,, ,,	*Nil*	A.G.	A.G.	A.G.	A.G.	A.G.
1½ ,, ,,	,,	*Nil*	*Nil*	A.G.	A.G.	A.G.
2 ,, ,,	,,	,,	,,	A.G.	A.G.	A.G.

IIIB. As above, but with a dose of ½ a part per million and the temperature of the water kept at 37° C. (i.e., under tropical conditions). No "second fractions.'' Control positive in one millilitre.

	Preformed			Bulk-formed		
	4 : 1	3 : 1	2 : 1	4 : 1	3 : 1	2 : 1
Concentration at start ..	0·55	0·50	0·55	0·50	0·50	0·50
Methyl-red test	Un-bleached	Un-bleached	Un-bleached	Un-bleached	Un-bleached	Un-bleached
Concentration after 2 hours	0·35	0·35	0·35	0·30	0·30	0·30
MacConkey's medium—						
½ hr. contact	*Nil*	*Nil*	*Nil*	*Nil*	A.G.	A.G.
1 ,, ,,	,,	,,	,,	,,	*Nil*	*Nil*
1½ ,, ,,	,,	,,	,,	,,	,,	,,
2 ,, ,,	,,	,,	,,	,,	,,	,,

At higher temperatures chloramine is much more effective, and at this concentration the preformed variety is more effective than the bulk-formed variety.

IIIC. The source of *B. coli* in this case was *sewage.* A sewage effluent was diluted 400 times with London tap-water and treated with one part of chloramine per million and inoculated as above, allowance being made for the small amount of ammonia already present. There was no "second fraction," and the control showed *B. coli* present in one millilitre.

	Preformed			Bulk-formed		
	4 : 1	3 : 1	2 : 1	4 : 1	3 : 1	2 : 1
Concentration at start ..	0·95	0·95	0·90	1·10	0·95	1·00
Methyl-red test	Un-bleached	Un-bleached	Un-bleached	Un-bleached	Un-bleached	Un-bleached
Concentration after 2 hours	0·85	0·90	0·90	0·95	0·90	0·90
MacConkey's medium—						
½ hr. contact	*Nil*	A.G.	*Nil*	*Nil*	Acid only	A.G.
1 ,, ,,	,,	*Nil*	,,	,,	*Nil*	*Nil*
1½ ,, ,,	,,	,,	,,	,,	,,	,,
2 ,, ,,	,,	,,	,,	,,	,,	,,

Naturally occurring *B. coli* is just as susceptible to the action of chloramine as are laboratory cultures.

TABLE IV.—BACTERIOLOGICAL RESULTS. OTHER ORGANISMS.

London tap-water sterilized by heat was inoculated at 15° C. with a saline emulsion of the organisms of resistant strains of bacteria from twenty-four hour cultures on agar slopes in quantity to give an estimated number of about 50,000 organisms per millilitre. The water was then treated with chloramine as in Table III, and fifty millilitres were inoculated into fifty millilitres of double strength Rideal Walker broth, controls of the water not treated with chloramine being put up at the same time after the requisite periods of contact. Peptone water instead of broth was used for the cholera. A positive sign in the tables indicates growth in the broth; a negative sign indicates sterility.

Bact. typhosum, Lister strain. One part of chloramine per million.

Time of contact	Preformed Chloramine			Bulk-formed Chloramine			Control
	4 : 1	3 : 1	2 : 1	4 : 1	3 : 1	2 : 1	Without chloramine
Start..	+	+	+	+	+	+	Not subcultured
½ hour	−	+	−	−	+	+	+
1 hour	−	+	−	−	−	−	+
1½ hours	−	−	−	−	−	−	+

A 4 : 1 ratio sterilizes in half an hour, other ratios take about an hour.

IVA. *Bact. paratyphosum* A. Mears' strain. One part of chloramine per million.

Time of contact	Preformed			Bulk-formed			Control
	4 : 1	3 : 1	2 : 1	4 : 1	3 : 1	2 : 1	
Start	+	+	+	+	+	+	Not subcultured
½ hour	−	+	+	−	+	+	+
1 hour	−	+	+	−	+	−	+
1½ hours	−	−	−	−	−	−	+

A 4 : 1 ratio kills in half an hour, other ratios take longer.

IVB. *Bact. paratyphosum* B. Rowland's strain. One part of chloramine per million.

Time of contact	Preformed			Bulk-formed			Control
	4 : 1	3 : 1	2 : 1	4 : 1	3 : 1	2 : 1	
Start	+	+	+	+	+	+	Not subcultured
½ hour	−	−	+	+	+	+	+
1 hour	−	−	+	−	−	+	+
1½ hours	−	−	−	−	−	−	+

Preformed chloramine appears to be more effective than the bulk-formed variety; 4 : 1 and 3 : 1 ratios sterilize in one hour.

IVc. *Bact. dysenteriæ* Shiga. One part of chloramine per million.

Time of contact	Preformed			Bulk-formed			Control
	4 : 1	3 : 1	2 : 1	4 : 1	3 : 1	2 : 1	
Start	+	+	+	+	+	+	Not subcultured
½ hour	−	+	+	−	−	−	,,
1 hour	−	−	−	−	−	−	,,
1½ hours	−	−	−	−	−	−	+

IVd. *Vibrio choleræ*, King Institute No. 5 strain. One part of chloramine per million.

Time of contact	Preformed			Bulk-formed			Control
	4 : 1	3 : 1	2 : 1	4 : 1	3 : 1	2 : 1	
Start	+	+	+	+	+	+	Not subcultured
½ hour	−	−	−	+	−	−	+
1 hour	−	−	−	−	−	−	+
1½ hours	−	−	−	−	−	−	+

The 4 : 1 bulk-formed half-hour contact subculture showed only traces of growth and indol. Hence, it may be regarded that 1 part of chloramine per million will kill the cholera vibrio in half to one hour.

Table V.—Deviation of Chloramine in Water containing Organic Matter.

Comparison of the effect of adding chlorine and preformed and bulk-formed chloramine to River Thames water raw and filtered, and to London tap-water. The Thames water already contained 1·5 parts of ammonia per million, and the tap-water was practically free from ammonia. Chlorine, as chlorosene emulsion, was added in equal quantities to each in sufficient quantity to produce theoretically 3 parts per million, and ammonium sulphate was used. In the case of the river water, the proportion was 1 : 1 (3 of chlorine + 1·5 of ammonia already in, + 1·5 of ammonia added, except in the case of chlorine alone) and in the tap-water 2 : 1, except in the case of chlorine alone. The figures are parts per million.

These tables show that the ammonia already in the water has a slight protective action on the chlorine, yet in the case of dirty water, such as swimming-bath water, it is advisable to use ammonia in addition to that already in the water, and preferably to use bulk-formed chloramine.

	Chlorine alone		
	Tap	Filtered	Raw
Initial concentration	2·60 + 0·0	2·10 + 0·0	1·95 + 0·0
One hour at 15° C.	2·60 + 0·0	2·00 + 0·0	1·95 + 0·0
,, ,, 60° C.	2·15 + 0·0	1·45 + 0·0	1·30 + 0·0

	Preformed chloramine		
	Tap	Filtered	Raw
Initial concentration	2·85 + 0·0	2·5 + 0·0	2·5 + 0·0
One hour at 15° C.	2·90 + 0·0	2·3 + 0·0	2·3 + 0·0
,, ,, 60° C.	2·85 + 0·0	2·3 + 0·0	2·3 + 0·0

	Bulk-formed chloramine		
	Tap	Filtered	Raw
Initial concentration	3·10 + 0·0	2·7 + 0·0	2·8 + 0·0
One hour at 15° C.	3·10 + 0·0	2·6 + 0·0	2·6 + 0·0
,, ,, 60° C.	3·05 + 0·0	2·5 + 0·0	2·3 + 0·0

TABLE VI.—CHLORAMINE IN THAMES WATER (BACTERIOLOGICAL).

This test showed the difference in sterilizing power of both preformed and bulk-formed chloramine on raw and filtered Thames water containing 0·9 parts NH_3 per million.

The water was filtered through sand and treated with 3, 2 and 1 parts of chloramine per million, using both preformed and bulk-formed chloramine prepared from chlorine gas solution and ammonium sulphate in the 4 : 1 ratio.

Fifty millilitres of the water were inoculated into fifty millilitres of double-strength Rideal Walker broth and incubated at 37° C. for two days. A positive sign shows growth, a negative sign sterility.

	Preformed chloramine					
	Raw water			Filtered water		
Concentration at start	3·0 + 0·7	2·0 + 0·6	0·90 + 0·25	2·9 + 0·7	1·80 + 0·60	0·9 + 0·2
,, after two hours	3·0 + 0·6	1·3 + 0·5	0·85 + 0·15	2·9 + 0·6	1·65 + 0·45	0·8 + 0·1
One hour's contact ..	+	+	+	−	−	+
Two hours' contact ..	+	+	+	−	−	+

	Bulk-formed chloramine					
	Raw water			Filtered water		
Concentration at start	3·4 + 0·0	2·20 + 0·0	1·0 + 0·0	3·3 + 0·0	2·2 + 0·0	1·0 + 0·0
,, after two hours	3·3 + 0·0	2·05 + 0·0	0·9 + 0·0	3·2 + 0·0	2·1 + 0·0	0·9 + 0·0
One hour's contact ..	+	+	+	–	–	+
Two hours' contact ..	+	+	+	–	–	+

These tables show that whereas 3 parts of chloramine per million would not sterilize raw Thames water in two hours, the filtered water was sterilized completely by 2 or more parts per million in one hour. The lack or slowness of penetration of the chloramine into the particulate matter appears to account for these results.

TABLE VII.—*Bact. typhosum* IN FILTERED THAMES WATER.

Chlorosene and ammonium sulphate in various ratios were used, giving a strength of 1 part of chloramine per million of filtered Thames water inoculated with *Bact. typhosum,* Lister strain, in normal saline from a twenty-four-hour agar slope. After one and one and a half hours' contact fifty millilitres were inoculated into fifty millilitres of double strength Rideal Walker broth, and in all cases growth occurred. The contents of each tube were inoculated into mannite (sugar) medium, which was found to be unaffected by the resistant organism in the water but gave with *B. coli* acid and gas, and with *Bact. typhosum* acid only after incubation at 37° C.

	Preformed chloramine			Bulk-formed chloramine		
	4 : 1	3 : 1	2 : 1	4 : 1	3 : 1	2 : 1
Concentration at start ..	1·00	1·0	1·0	1·0	1·0	1·0
,, after two hours	0·85	1·0	1·0	0·8	0·9	0·9
One hour contact	A.G.	A.G.	A.G.	A.G.	Acid only	Gas only
One hour and half contact	*Nil*	*Nil*	Acid only	*Nil*	*Nil*	*Nil*

These results show that for all practical purposes 1 part of chloramine per million will kill *Bact. typhosum* in filtered polluted water in between one and one and a half hours.

[The Director of Hygiene informs us " that the use of chloramine for the purification of water in the field, both in the Regimental Water Cart (McKibbin's method) and in the Elliott Mobile Water Purifier, is at present undergoing practical tests, the results of which will be published in due course."—ED.]

QUININE PROPHYLAXIS IN NORTHERN INDIA.

By Major T. YOUNG,
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(*Continued from p.* 98.)

III.—The Theory of Quinine Prophylaxis.

Quinine is not regarded as a true prophylactic to malaria. It does not prevent infection of the red blood-cells by the parasites, but, if given in sufficient doses and over a long enough period, it may prevent an attack of malaria in an individual who has been bitten by an infective mosquito, and allow him to carry out his normal duties.

If there were ever any real doubts on the subject these have been laid to rest as a result of the celebrated work of Yorke and Macfie already referred to. They established that in order to prevent attacks of malaria developing quinine had to be continued ten days at least after the infective bite, and they considered that quinine failed to destroy all, if any, of the sporozoites. The reason for this failure is shown by the work of Acton [31], who found that, after a single dose of ten grains of quinine, the maximum concentration of quinine in the blood was only 1 in 250,000, a very much weaker concentration than is necessary to kill off all parasites.

Warrington Yorke [32] (in collaboration with Macfie) has confirmed the work of Muhlens and Kirschbaum (1924) that quinine in concentrations considerably greater than can ever occur in the blood-stream does not *in vitro* destroy all the malaria parasites. He found that a mixture of simple tertian blood and of a 1 in 5,000 solution of quinine is infective after incubation at 37° C. for two and a half hours. Evidence is produced to show that the susceptibility to treatment in the induced malaria is bound up with the fact that in these cases one is concerned with the treatment of primary infections. The mechanism by which a cure is obtained in malaria is considered at length and the conclusion reached that the essential factor for the production of cures is the capacity of the host to produce immune body formation in response to antigen resulting from the destruction of a considerable number of merozoites, whether due to quinine treatment or to the natural powers of the patient. If for any other reason the immune body formation is insufficient the infection is not sterilized and a relapse occurs.

The failure of treatment in chronic relapse cases is explicable on the same hypothesis. The parasites in such cases are not quinine resistant, but immune body resistant. In primary cases, on the other hand, treatment does produce a cure, firstly because the immune body normally present to some extent in the blood of all patients is augmented as the result of the

antigen formed by the action of the quinine on the parasites, and, secondly, because the parasites have not yet become immune body resistant.

Interesting though this hypothesis may be, it should be borne in mind that it is still only a hypothesis and that all the evidence adduced in its favour is indirect.

Whether we accept the hypothesis of Yorke or not, it would appear from the above that quinine prophylaxis is merely a form of early treatment given in the incubation period before there are sufficient parasites present to cause a paroxysm, and that the quinine assists the natural defences of the body.

In whatever form quinine is administered, it circulates in the blood as quinine base. It is present in the plasma, is adsorbed on to the surface of the erythrocytes, but not within them. Hence such parasites as may have become intracellular escape its action. When the infected red cells burst, setting free in the blood plasma swarms of little merozoites, these merozoites attach themselves to fresh red blood-corpuscles to initiate again the schizogony cycle. The malaria parasites are therefore extra-cellular in their earlier trophozoite phase. Most malariologists, however, affirm that early in the process of development the trophozoite penetrates into the interior of the cell, and that both the schizont and gametocyte are intracellular.

M. Rowley-Lawson does not agree, and in a series of papers (1912-1919), beautifully illustrated, she maintains the view that the parasites are extra-cellular throughout the whole of the cycle in their human host, and that they wander about in the blood-stream from one blood-cell to another, applying themselves to the surface of the cells, but never penetrating into them.

Stephens and Gordon [33] hold similar views and, as a result of their studies on the relationship of the crescent to the erythrocytes, formed the opinion that the crescents were extra-cellular and applied only to the surface of the red cells.

Also, Sinton [34], by shrivelling erythrocytes with hypertonic saline and swelling them with hypotonic, believes that he has seen the parasites in the various extra-corpuscular positions observed by Rowley-Lawson.

The question as to whether or not the parasite is extra-cellular during most of its life in the human body is interesting from the point of view of treatment. If the extra-corpuscular theory is correct, then the parasite, from the injection of the sporozoite by the mosquito throughout the whole of the schizogony cycle, and during that part of the sporogony cycle up to the formation of the gametocytes, is exposed to the action of quinine circulating in the blood; whilst if the view of the majority is the correct one, the parasite can only be affected by quinine during the sporozoite stage, the merozoite stage and the early trophozoite stage, and it is in the merozoite stage that the parasite is generally held to be most susceptible to the action of quinine.

Therefore it would appear that the weak concentrations of quinine present in the blood during treatment or during a course of prophylactic quinine exercise their lethal or weakening effect on the parasite during the sporozoite, early trophozoite and merozoite stages at least, and if the extra-corpuscle theory is correct throughout the whole of the rest of the life of the parasite in the human host besides.

It follows that our aim should be to maintain in the blood a concentration of quinine sufficient to destroy all parasites directly or indirectly, and to determine the minimum dosage for this purpose. The dose will require to be higher when the number of infected anopheles is high, during epidemic years, and when other measures of protection are ineffective.

The process will be less efficacious if circumstances exist which tend to lower the resistance of the individual, e.g., stress and strain of active service, exposure to climatic extremes. The well-known fact that a mild attack of malaria adequately treated with quinine will often not clear up till the patient retires to bed, is a very good indication that factors other than quinine play their part in the cure of malaria.

Another factor influencing the dosage is the arrival in the station of batches of non-immunes. Their advent in the ordinary way during the malaria season is often the signal for a great intensification of the malaria, and not only the new arrivals, but the old residents suffer. The non-immunes get infected, the percentage of infected anophelines increases, and the degree of immunity in the old residents is now insufficient to protect them. This is well exemplified after the return to the plains stations in India of parties of troops who have been spending part of the hot weather in the hills.

Watson [35] observed the same phenomenon after the arrival of recruits for labour gangs on the estates of Malaya.

Whatever the environmental conditions, the dose should be sufficient not only to prevent the number of parasites rising above the febrile threshold, but, if possible, to destroy all parasites. The exhibition of quinine must be continued for at least ten days after the latest possibility of infection. We may picture the state of affairs when the body defences and quinine in circulation are just sufficient to scotch, but not to exterminate, the infection. Perhaps fresh infections are constantly being superimposed. The schizogony cycle persists for very long periods, but the number of parasites in the blood-stream is kept at a low level.

At the end of the malaria season, no further fresh infections occurring, the continuation of the quinine for ten days may kill off the infection. On the other hand, the infection may persist till some cause reduces the individual's power of destroying parasites, the schizogony cycle flares up, the total number of parasites rises above the febrile threshold and an attack of malaria ensues.

It is often argued that quinine prophylaxis only masks malaria infection and that when the quinine is stopped the mask is removed and an outbreak

of malaria necessarily follows. Such has not been my experience. If the dose has been sufficient to keep an outbreak of malaria in check, and if the course of quinine is continued for ten days or a fortnight after the danger of further infection has ceased, it is maintained that "masked" cases are the exception, not the rule.

Even in individuals taking no quinine it is well known that cases occur where the disease does not manifest itself till long after infection has taken place.

I will quote two cases within my knowledge.

(1) E. C. H. had his first attack of malaria five months after returning to England, following a prolonged spell of residence in India.

(2) S. M. R. A. returned to England from India on February 5, 1931. During six years in India he had kept perfectly fit and had not had a single day's sickness. He was posted to Catterick (Yorks), and later (September, 1931) developed a typical attack of malaria B.T. He had a rigor on September 6, 1931, followed by another on September 8, 1931, when B.T. parasites were found in the blood. The condition rapidly responded to treatment with quinine.

The question of susceptibility to infection is very imperfectly understood. Some individuals appear to be immune; whether mosquitoes will not bite them, or whether actual resistance to infection exists, is hard to say. I know of one officer (R. T. H.) who slept outside without a net or any other protection in an area where it was impossible for the ordinary individual to sit in comfort after dark. He stated he was never bitten. Another officer (J. N.) had been stationed in many intensely malarious parts of India over a period of seventeen years, and had escaped infection, though he took no precautions against malaria. His resistance against other diseases and his general physique were poor, but repeated and thorough investigation failed to show any trace of malaria.

A further difficulty is the fact that a proportion of any group to whom quinine is given will not absorb the drug in the form usually given, i.e., the sulphate, for it is well known that cases of malaria will frequently react to the bihydrochloride after treatment with sulphate has failed.

It is also necessary to ensure the efficient action of the liver by occasional sharp purges. Otherwise, in many cases, the quinine administered may not be fully absorbed.

Another drawback put forward against the use of quinine prophylaxis is that there is the possibility of producing an immunity to quinine on the part of the parasites, so that the action of quinine when required in curative doses is reduced or lost. The evidence, however, that quinine-fast parasites are produced by the prolonged administration of quinine when given either as a prophylactic or curative is far from being convincing, and Acton [36] and his colleagues of the Dagshai Malaria Hospital are of opinion that the parasites do not become quinine-resistant.

Much has been written of the so-called dangers of quinine administra-

tion. It is well known that in large doses quinine depresses the heart, lowers the blood-pressure and causes depression of the nervous system with a sense of misery and dejection. Atrophy of the optic nerve may follow. In a few particularly susceptible individuals, quinine may produce severe symptoms, e.g., hæmoglobinuria, skin eruptions and severe abdominal colic. Such cases are extremely rare, however, when we consider how much quinine is consumed (the annual consumption in India is about 160,000 pounds) [37]. It has even been said that quinine is the cause of blackwater fever. Veretas (Greece, 1858) originated the theory, and Tomaselli (Italy) and Koch later supported it. Much harm was done before this view was discountenanced, and it is now known that blackwater fever may develop without the previous administration of quinine.

I have never seen any serious ill-effects following the use of quinine in the ordinary doses required for treatment, viz., twenty-four to thirty grains a day, and in the course of his large experience Sir Malcolm Watson [38] has only seen one case of idiosyncrasy.

Cinchonism does not persist for more than a few days, and in cases of indigestion a change of salt or an increase in the dosage usually cures the condition.

Quinine, however, is admittedly an unpleasant drug to take, and care must be exercised in choosing the best time and the most suitable method of administration in order to minimize its effects. Largely also on account of its taste it is unpopular, and in dealing with large groups the closest supervision is required to ensure its consumption, for otherwise results will be disappointing. A soldier has been known to place a sponge in his mouth to soak up the quinine he was supposed to swallow.

The supervision required must extend to the preparation of the drug, and frequent examination must be made to ensure that the dose ordered is actually being administered. A solution labelled as containing ten grains to the ounce has been shown to contain only one grain [39], and quinine tablets have been found undissolved in the stools. In cases of doubt the urine should be examined for the presence of quinine.

(*To be continued.*)

REPORT ON AN INVESTIGATION OF ENERGY EXPENDED ON THE EXERCISES OF THE PHYSICAL TRAINING TABLES FOR RECRUITS OF ALL ARMS.

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(*Continued from p.* 118.)

Table LXII.

(VII) Dorsal Exercises.

Table	Calories	Exercise
1.	70	F.astr. H.f.—Trunk bending backward.
	81	F.astr. H.f.—Trunk bending forward.
Mean ..	75	
2.	75	As before.
	159	Kneeling, sitting on Heels, Hands clasped behind Back, Forehead on Knees.—Back stretching.
Mean ..	117	
3.	273	Trunk bending downward and up to Arms bend position.
4.	263	Tr.forw.b.—Arms swinging backward, forward and upward.
	168	Forward lying.—Hips firm.
	199	Sit. pos. L. straight, Feet grasp.—Trunk bending downward.
Mean ..	210	
5.	195	F.sidew.pl. A.forw.b. Tr.forw.b.—Arms flinging.
	158	Forw.lying H.f.—Trunk bending forward and backward.
	126	Lying face downward, A.sidew.str.—Trunk raising (on ground).
Mean ..	160	
6.	181	Forw. lying A.b. Trunk bending forward and backward, Arms stretching sideways.
	139	F.astr. A.upw.str.—Trunk bending forward.
	199	Sit.pos. L. straight, F. grasp.—Trunk bending forward.
Mean ..	173	

The mean values of the exercises, Tables 5 and 6, do not show that gradation in progression which one might expect. Explanation of this is partly afforded by the remarks under Tables XLIV, XLV and XLVI.

TABLE LXIII.

(VIII) FINAL AND CORRECTIVE EXERCISES.

Table	Calories	Exercise
1.	85	Heels raise.
	116	Arms bending and stretching (slowly) (various directions).
	214	Marching with Toe leading.
	69	With Fingers stretching, Head bending backward.
Mean ..	121	
2.	167	H.f. Heels raising and Knees bending.
	128	Arms swinging upward.
	63	With Fingers stretching, Head bending from side to side.
Mean ..	119	
3.	99	H.f.—Foot placing sideways.
	128	A.forw. r.—Arms parting.
	78	With Fingers stretching, Head turning from side to side.
Mean ..	102	
4.	193	H.f.—Heels raising and Knees full bending.
	149	A. sidew. str.—Arms swinging forward and backward.
	69	With Fingers stretching, Head bending backward.
Mean ..	137	
5.	187	F. full o. H.f.—Lunging outward.
	237	F. full o. H.f.—Lunging outward.—Arms bend.
	145	A.forw.b.—Arms flinging.
	64	Head bending forward and backward.
Mean ..	158	
6.	188	F. full o. A.forw.b.–Outward lunging.
	203	F. full o. A.forw.b.—Outward lunging. Arms bend.
	105	Arms bending and stretching with Fist clenched (slowly) (various directions).
	66	With Fingers stretching, Head rolling.
Mean ..	140	

Progression is not of importance in this group of exercises, but it is shown in the mean values throughout the tables with the exception of 3.

Corrective exercises are the same throughout all the tables.

Table	Calories	Exercise
All	82	F.astr. H.f.—Deep breathing.
	53	Position of attention.
Mean ..	67	

C.—TABULATION OF EXERCISES IN THEIR GROUPS OF TABLES I TO VI OF THE MANUAL OF PHYSICAL TRAINING BY ORDER OF THEIR ENERGY EXPENDITURE VALUES.

The following tables, LXIV to LXXI, give the exercises in their respective groups of Tables I to VI, in order of their calorie expenditure,

excluding the Agility Exercises. These lists are given as they might be of help, at some future date, in the drawing up of fresh Physical Training tables.

TABLE LXIV.

MARCHING AND RUNNING EXERCISES.

Calories	Exercise	Table
132	Slow march	5
172	H.f.—With Knee raising mark time	2
182	H.f.—With Knee raising march	4
192	Quick march	1
219	H.f.—In quick time sideways march	3
235	Quick march.—Heels raise	1
252	Marching with opposite Knee and Arm raising	2
256	Mark time with opposite Knee and Arm raising	1
333	Rapid march	3
382	Running on the spot	4
383	H.f.—With Knee raising double mark time	4
450	Double march	1 and 2
457	H.f.—On alternate Feet hop	3
484	H.f.—In double time sideways march	5
497	Hopping with opposite Knee and Arm raising	6
517	On alternate Feet hop with Arms raising sideways	5
538	On alternate Feet hop with alternate Arms swinging upwards	6

TABLE LXV.

INTRODUCTORY EXERCISES.

Calories	Exercise	Table
135	Small Arms swing with Feet placing sideways	4
147	Small and large Arm swings	2
179	F.astr., A.l.c.—Arms fling from low cross to sideways stretch	1
252	A.l.c.—Heels raising with Arms flinging to flight	3
260	F.astr.Tr.forw.b.—Floor beat with Knees straight	4
273	F.astr.—Trunk twisting with alternate Arm flinging	4
281	F.astr.Tr.forw.b.—Arms swinging backward, forward and upward	2
283	F.astr., One hand H.f.—Arm circling	1
286	F.astr.H.f.—Trunk bending downward (quickly)	2
289	F.astr.Tr.forw.b.—Floor beat with Arms swinging backward, forward and upward. (Knees straight)	5
292	Hopping with Leg raising sideways	4
307	High kicking at Hand	5
312	A.l.c. Heels raising and Knees bending with Arms flinging to flight	4
318	F.astr.—Floor beat and Trunk stretching forward with Neck rest. (Varied)	6
324	Heels raising and Knees bending with Arms forward raising, forward bending, flinging and lowering	3
329	Heels raising and Knees bending, with small and large Arm swings	5
346	H.f.—Hop with Toe placing forward	2
355	Hopping with Leg raising sideways, and opposite Arm raising to flight	6
357	H.f.—Hop with Toe placing sideways and forward	3
366	H.f.—Hop with Toe placing sideways	1
397	Astride jumping with Arm raising sideways	2
400	H.f.—Astride jumping	1
417	Small jumps with single Arm stretching	2
418	Astride jumping with Hands clap above Head	5
432	H.f., K.full b.—Jumping forward, sideways and upward	6
456	Small jumps with Arms stretching (various directions)	6
497	Jumping with alternate Arm stretching (various directions)	3

TABLE LXVI.

HEAVING EXERCISES.

Calories	Exercise	Table
119	Arch hanging	1
131	Fall hang	2
141	Overgrip	3
160	Arms stretching forward, sideways, upward and downward	1
161	Oblique grip	4
195	Undergrip	4
199	Arch hanging Arms bend	2
210	Fall hang.—Arms bend	3
232	Overgrip.—Side travelling with swing	6
242	Crossgrip.—Arms bend	3
245	Overgrip.—Side travelling changing grip	5
262	Undergrip.—Upward circling (Beam Head height)	5
281	Undergrip.—Upward circling (Beam stretch height)	6
282	Overgrip.—Arms bend	3
285	Undergrip.—Arms bend	4
297	Oblique grip.—Arms bend	4
305	Climbing (down Hand under Hand without use of Feet)	4
326	Climbing with use of Feet	3
329	Mounting shelf (with assistance)	6

TABLE LXVII.

LATERAL EXERCISES.

Calories	Exercise	Table
125	H.support. One A.upw.str. One hand H.f.—Trunk bending sideways. (Beam)	6
134	F.cl. One A.b., One Hand H.f.—Trunk bending sideways with Arm stretching upward	2
170	On K.L.(R.)L.sidew.str .Hands on Hd.—Trunk bending sideways	3
183	F.astr.H.f.—Trunk bending from side to side	1
184	On the Hands on ground.—On the left (Right) Hand turn, Leg raising	3
204	One Arm upw.str., One Hand H.f., F support.—Trunk bending sideways	5
206	On the Hands on ground, at the wall bars.—On the left (Right) Hand turn, Leg raising	3
207	Sit.pos.—Trunk twisting with single Arm flinging	5
209	Sit.pos.—Trunk bending sideways (quickly)	2
215	F.astr.,One Hand H.f.—Trunk twist and single Arm fling	1
215	H.f.,F.support.—Trunk bending sideways	4
219	Trunk bending from side to side (quickly)	6
240	On Hands and Knees.—Trunk twisting with single Arm flinging	3

TABLE LXVIII.

BALANCE EXERCISES.

Calories	Exercise	Table
90	H.f.—Knee raise	1
100	H.f.—Leg raising sideways	1
102	H.f.—Leg raising sideways and backward	2
106	Walking backward and forward on benches (laid side by side)	2
115	H.f.—Leg raising forward, sideways and backward	3
120	H.f., H.r., Leg stretching forward and backward	3
123	Leg raising forward, sideways and backward with Arm raising forward, sideways and upward	6
126	Leg raising forward with Arm raising upward	5
127	H.f. K.r.—Leg stretching forward, sideways and backward	4
158	A.b., Kr.—Leg and Arm stretching (various directions)	6
174	Mount with Foot assisting, walking forward and backward (Beam waist height)	5
182	Mounting beam (Knee height) turning about	3
186	Mounting beam (Knee height)	3
208	Mount with foot assisting, walking forward and downward jumping (Beam waist height)	5 5
236	Mount with Foot assisting, walking forward (Beam shoulder height)	6

TABLE LXIX.

ABDOMINAL EXERCISES.

Calories	Exercise	Table
126	On the top bar (Wall bars)	1
146	On the Hands on ground	2
150	Overgrip.—Knees raise (Beam)	5
175	On the top bar.—Knees raise	3 and 4
179	Back against the wall bars, str.height and grasp.—Left (Right) Knee raising, stretching and lowering	1
200	Lying on the Back.—Body raising to forward reach and Legs raising (alternately)	6
218	Lying on Back, Arms sidew.str.—Body raising and forward reaching (Arms assisting)	1
218	On the top bar.—Left (Right) Knee raising, stretching and lowering	2
218	On the Hands on ground.—Arms bend	3 and 4
218	On the top bar.—Legs raising	6
232	Lying on the Back, Arms upw.str.—Body raising to forward reach and Trunk stretching upward with Arms raising sideways (alternately)	3
233	Lying on the Back, A.upw.str., K.r. Feet on floor—Legs stretching and body raising to forward reach	2
240	Lying on the Back, A.upw.str.—Trunk raising and floor beat	4
244	Lying on the Back.—Trunk raising to forward reach and stretching upward with Hands placing backward (alternately)	5
251	On Hands on ground.—Foot placing forward	5
252	F.astr.N.r.Tr.forw.b.—Trunk bending downward	1
303	On Hands on ground.—Feet placing forward	5

TABLE LXX.

DORSAL EXERCISES.

Calories	Exercises	Table
70	F.astr.H.f.—Trunk bending backward	1
81	F.astr.H.f.—Trunk bending forward	1
126	Lying face downward A.sidew.str.—Trunk raising (on ground)	5
139	F.astr.A.upw.str.—Trunk bending forward	6
158	Forw.lying. H.f.—Trunk bending forward and backward	5
159	Kneeling, sitting on heels, Hands clasped behind back, Forehead on Knees.—Back stretching.	2
168	Forw.lying—Hips firm	4
181	Forw.lying A.b.—Trunk bending forward and backward, Arms stretching sideways	6
195	F.sidew-pl.A.forw.b.,Tr. forw.b.—Arms flinging	5
199	Sitting pos.L.straight F.grasp.—Trunk bending downward	4 and 5
263	Tr.forw.b.—Arms swinging backward, forward and upward	4
273	Trunk bending downward and up to Arms bend position (quickly)	3

TABLE LXXI.

FINAL AND CORRECTIVE EXERCISES.

Calories	Exercise	Table
53	Position of attention	1 to 6
63	With Fingers stretching, Head bending from side to side	2
64	Head bending forward and backward	5
66	With Fingers stretching, Head rolling	6
69	With Fingers stretching, Head bending backward	1 and 4
78	With Fingers stretching, Head turning from side to side	3
82	F.astr.H.f.—Deep breathing	1 to 6
85	Heels raise	1
99	H.f. Foot placing sideways	3
105	Arms bending and stretching with Fists clenched (slowly). (Various directions)	6
116	Arms bending and stretching (slowly). (Various directions)	1
128	Arms swinging upward	2
128	A.forw.r.—Arms parting	3
145	A.forw.b.—Arms flinging	5
149	A.sidew.str.—Arms swinging forward and upward	4
167	H.f.—Heels raising and Knees bending	2
187	F.full o. H.f.—Lunging outward	5
188	F.full o. A.forw.b.—Lunging outward	6
193	H.f.—Heels raising and Knees full bending	4
203	F.full o. A.forw.b.—Lunging outward, Arms fling	6
214	Marching with toe leading	1
237	F.full o. H.f. Lunging outward.—Arms bend	5

D.—COMPARISON OF FIRST SIX TABLES SHOWING THE MEAN VALUE OF THE EXERCISES IN EACH GROUP AND ALSO THE MEAN OF THE TOTAL EXERCISES IN EACH TABLE.

Below in tables is shown a comparison of Tables I to VI of the Manual, in which the mean value of each group is given, also the mean of the total exercises in each table. Agility exercises are not included.

TABLE LXXII.

TABLES I–VI (EXCLUDING JUMPING AND VAULTING, HORSE AND GROUND WORK).

Group	Table I	Table II	Table III	Table IV	Table V	Table VI
Marching and Running	283	289	324	318	363	473
Introductory	307	317	339	250	336	390
Heaving	139	219	229	249	263	287
Lateral	199	171	187	201	206	205
Balance	95	104	151	167	150	172
Abdominal	194	199	208	216	237	209
Dorsal	75	117	273	210	160	173
Final	121	119	102	137	158	140
Corrective	67	67	67	67	67	67
Mean of all Exercises..	183	203	223	216	236	243

E.—COMPARISON OF THE MEAN VALUE OF ALL EXERCISES IN ALL EIGHT TABLES, INCLUDING JUMPING AND VAULTING, BUT EXCLUDING HORSE AND GROUND WORK.

It must be remembered that only one experiment was carried out on the exercises in Tables VII and VIII of the Manual, and also on the Jumping and Vaulting group in the other tables.

TABLE LXXIII.

TABLES I TO VIII (EXCLUDING HORSE AND GROUND WORK).

Group	Table I	Table II	Table III	Table IV	Table V	Table VI	Table VII	Table VIII
Marching and Running..	283	289	324	318	363	473	469	469
Introductory	307	317	339	250	336	390	358	329
Heaving	139	219	229	249	263	287	352	333
Lateral	199	171	187	201	206	205	168	202
Balance	95	104	151	167	150	172	164	170
Abdominal	194	199	208	216	237	209	145	228
Dorsal	75	117	273	210	160	173	173	200
Jumping and Vaulting ..	327	328	273	326	367	391	370	370
Final	121	119	102	137	158	140	128	138
Corrective	67	67	67	67	67	67	67	67
Mean of all Exercises ..	195	223	233	229	249	266	251	258

Remarks.—The mean expenditure of the Marching and Running and Introductory groups is higher throughout than for any of the others. This may be explained by the fact that leg exercises figure largely in these two groups, and it will have been noted that the expenditure in leg exercises, where the full force of gravity acting on the body is counterbalanced, is higher than in those where the weight of the body is not so borne.

It is difficult to give a summary of a report such as this, but one thing stands out prominently, and that is the order and formation of the

exercises throughout the tables are in accord with the results of this investigation, and therefore require very little criticism. Even with the knowledge of the calorific expenditure as a guide, the tables could scarcely have been bettered. One or two minor alterations have been suggested, and it is hoped that they may be of use if and when new tables are drawn up.

The object of the investigation, as mentioned in the first sentence of the Introduction, has indubitably been obtained, as the results do give a very decided support to the formation of the Physical Training Tables for Recruits of all Arms.

(*Abbreviations used in the Tables.*)

(As from Sheet 10 of Table Card excluding "Notes" and "Games.")

A.	= Arm or Arms.	Intro.	= introductory.
A.b.	= Arms bend.	J.	= Jumping.
Abd.	= Abdominal.	K.	= Knee or Knees.
A.l.c.	= Arms low cross.	K.b.	= Knees bend.
Alt.	= Alternate.	L.	= Leg or Legs.
astr.	= astride.	Lat.	= Lateral.
backw.	= backward.	Mar.	= Marching.
Bal.	= Balance.	N.	= Neck.
b.	= bend or bending.	N.r.	= Neck rest.
cl.	= close or closing.	o.	= open.
Cor.	= Corrective.	oblique gr.	= oblique grip.
crossgr.	= crossgrip.	outw.	= outward.
Dor.	= Dorsal.	overgr.	= overgrip.
downw.	= downward.	pl.	= place or placing.
F.	= Foot or Feet.	pos.	= position.
Ex.	= exercise.	r.	= raise or raising.
F.cl.	= Feet close.	sidew.	= sideways.
F.full o.	= Feet full open.	sit.	= sitting.
f.	= firm.	sp.b.	= span bending
fling.	= flinging.	str.	= stretch or stretching.
forw.	= forward.	swg.	= swing or swinging.
H.	= Hip or Hips.	Tr.	= Trunk.
Hd.	= Head.	turn.	= turning.
hang.	= hanging.	upw.	= upward.
H.f.	= Hips firm.	undergr.	= undergrip.
Hl.	= Heels.	V.	= Vaulting.
Hvg.	= Heaving.	Wk.	= work.
inw.	= inward.	Fin.	= Final.
Gd.	= ground.	R.	= running.
Hse.	= horse.		

(*To be continued.*)

ALUMINIUM VESSELS AND FOOD CONTAMINATION.

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(*Continued from p.* 107.)

A few workers have used the hydroxyquinoline method, but Gwyer and Pullen [8] have shown that it is not reliable in the presence of much calcium, as is the case with biological material in general.

One point which has been left for separate consideration is the question of the action of tap-water on aluminium vessels. According to Major Stanley Elliott [13], the amount of aluminium in the water held in the cavalry water-bottle for reasonable periods is one grain per gallon. This is specially kept acid for sterilization purposes at a pH of 3·0, so that it forms a stringent test of aluminium corrosion. The above figure works out at ¼ grain or 16 milligrammes per quart-bottle.

No evidence exists that cavalrymen suffer to a larger extent from gastric trouble than men who use the iron bottles.

As early as 1893 Plagge and Lebbin [14] had examined this question. They found weak acid or salt water—but not distilled water—gave rise after a long time to white spots which they attributed (not without some justification) to silicic acid. They acquit aluminium of being corroded by water even when acidulated, but their results are not of importance because of the inaccurate analytical methods employed.

In the previous year, Balland [15] used the method of measuring the loss in weight of aluminium strips when immersed in liquid foods, etc. He states that, among other beverages, water has less action on aluminium than on iron, copper, lead, zinc or tin. His aluminium was only 97 per cent pure, so more liable to attack than modern specimens. However, it is best to ignore these early experiments because of the relative insensitivity of the analytical methods employed. In 1913, experiments in the *Lancet* Laboratory [6A] and independently by Glaister and Allison [6B] showed that on boiling with water no aluminium was found in solution or in the suspended solids. It is to be regretted that the analytical methods were not disclosed. In recent years, among others, Haase [16] exposed aluminium water-bottles to the action of water, the metal being of 98·6 to 99·1 per cent purity. He exposed them for eighteen days and measured the amount of aluminium in the whitish spots formed. He describes his analytical method as being "according to the usual method, the aluminium was precipitated as hydroxide, by ammonia and ignited to oxide and weighed as such." The

average amount of aluminium dissolved from a quart bottle per diem was nine milligrams, the largest amount being 14·5 milligrams.

In 1931, von Fellenberg [4] carried out several experiments on the effect of boiling water in aluminium vessels ; 500 cubic centimetres, for example, were evaporated to a small bulk, a process which takes several hours, and the average found in several pans was 2·25 milligrams, representing 4·5 parts per million, The limiting values were 1·8 to 9·8 parts per million. Another trial was made of 500 cubic centimetres boiled for three and a half minutes. In this series 3·4 parts per million were dissolved. This compares well with the figures of Lampitt and Sylvester, who found that two parts per million were removed by boiling for half a minute.

It is clear also from the above that boiling for a long period with water does not appreciably increase the minute amount initially dissolved.

There should, therefore, be no fear that the storing of water for a day or two in aluminium bottles will dissolve harmful amounts, nor will the employment of aluminium vessels for boiling quantities of water.

At this stage, on the one hand, we can say that large doses of aluminium salts providing over 300 milligrams per diem, or 100 parts per million on a 2 kilogram diet, can be consumed without harm over a course of seven to nine months ; and, on the other hand, that the daily amounts removed from aluminium cooking vessels by the action of the foodstuffs are 5 milligrams or 2·5 parts per million for the same diet.

The question might be raised whether these small amounts removed from the vessels and ingested year after year for many years might not eventually cause digestive or other disorganization.

The report of the United States Agricultural Bulletin giving the results does not mention what proportion of the total ingested aluminium was excreted in the fæces. The fæces were analysed definitely for aluminium by the Schmidt and Hoagland method, and Dr. Verney [13] states that these workers found 99·9 per cent excretion. This is a reliable method for estimating the rather large amounts administered in these experiments, being a wet digestion method followed by careful precipitation of aluminium phosphate by ammonium phosphate and ammonium acetate, the iron being kept in solution in a reduced state by means of ammonium thiosulphate. (It would not, of course, be suitable for determining the minute amounts of aluminium removed by foods from utensils.) Experimental investigation of the fæces for resorption of aluminium by the tissues from the intestine, when the subjects of experiment were fed on diets of low phosphorus content, proved conclusively that there was no resorption of aluminium. Dr. Burn [1] quoted experiments on rats and pigs to show that in the former case 91 per cent of ingested aluminium is excreted from the fæces, and in the latter 97·5 per cent.

More conclusive are the experiments of Underhill and Peterman, which he quotes, as these workers used Atack's monosodium alizarinsulphonate-lake method which is practically of the same order of sensitivity as the

aluminon-lake or Hammett and Sottery method. They show that aluminium may or may not be present in the blood of normal men, but feeding them with aluminium does not increase the amount present.

We can conclude that the likelihood of small amounts of aluminium accumulating over a period of years and finally causing disturbance is small. This conclusion is supported by the experiments on guinea-pigs referred to at the beginning of this paper [2].

However, more definite support to this conclusion arises from the results of investigations on the aluminium content of plants and other biological material. It has been mentioned *en passant* above, that the Mellon Institute researchers found definite contributions of aluminium from the foods themselves, and more figures will be given later. Much work in the past has been carried out to discover whether plants, human organs and other biological material contained aluminium in their natural state. The quantities found by Myers and Voegtlin [17], in 1914, are rather large and in entire disagreement with other workers. No account is given in their paper of the method of analysis employed, and hence their paper should not be taken into consideration.

Up to 1928, investigators had been using gravimetric methods such as the Schmidt and Hoagland [18], which were accurate enough for fæcal analyses where the amounts present were relatively large, but not so for determinations of aluminium in living material. As Patten and Winter [19] pointed out in their work on a method of estimating aluminium in the presence of calcium, magnesium and phosphate (which are the disturbing factors principally present in biological material), gravimetric methods are unreliable with plant determinations since the final material obtained is very minute, even if the original bulk of raw material was large. In 1928, McCollum, Rask and Becker [20] used a spectrographic method of exciting the ash from plant residues with a spark, and recording the spectra on plates. The numbers and relative intensities of various lines, especially the *raies ultimes*, were in later work in 1931 correlated with known amounts of aluminium by visual inspection of the spectrophotographs. Then these were used as standards for spectra obtained from ashes of unknown aluminium content. But McCollom and his colleagues only used the two lines 3944·0 and 3961·5. Unlike any other observers before or since, they concluded that aluminium was not a constituent of any plant material. Kahlenberg and Closs, in 1929 [21], adversely criticized the technique of these workers, and repeated their work, using an arc instead of a spark, since the latter blows away the ash, thus causing low figures to be obtained, because the excitation can only be momentary under these conditions. They obtained positive results for various animal and vegetable materials. In 1931, Tourtellotte and Rask [22] critically examined this spectrographic method, and state that the correlation of the factors mentioned above must be most rigidly controlled. They adopted a conventional division of intensities varying from lines completely invisible by a lens, visible by the

eye, to those sufficiently heavy to cause a fogged line. They also found the spark gave low results in certain cases such as rat viscera and egg ashes, using duplicate experiments with the arc excitation. According to them, the biological materials examined, such as thyroid, potato, eggs, carrot, nut, etc., show a low concentration of aluminium from 0·5 to 2 parts per million in fresh tissue by the arc method. As pointed out by Bilham, the grave drawback of this method is the variability of the spark. The method often gives low results, and the accuracy is much less than that of colorimetric methods. According to the investigations of Tourtellotte and Rask, the method has an error of 25 per cent. Any deductions from results obtained by this method—especially negative findings—should be accepted very cautiously.

Workers, however, using the aluminon-lake methods (whether the aluminon one first checked by Myers and his colleagues, and utilized by Winter and Bird, Schwartze, Murphy and Cox, or the almost equally sensitive alizarin-sulphonate method of Atack employed by Underhill and Peterman [23]), find that aluminium is a widespread constituent of plants. Myers and his colleagues [11] applied their method to human material obtained at autopsy.

Their average results in p.p.m. of aluminium are :—

Brain	2·5 (8 samples)
Heart	2·1 (8 ,,)
Liver	0·8 (7 ,,)
Gall-bladder and bile	0·7 (5 ,,)
Kidney	1·0 (7 ,,)
Spleen	0·7 (6 ,,)

Later, Underhill and his colleagues [24] found in the liver 1·7 to 11·7 (the latter from a "fatty" liver), and in the kidneys 1·3 to 8·7, but their results sometimes appear high as compared with other investigators. In the next year following Myers' work, Winter, Thrun and Bird [25] attacked the problem of a satisfactory method of estimating aluminium in plant materials, etc. They reviewed the aluminon-lake method as used by previous workers, and thoroughly investigated the conditions affecting the accurate use of the lake. Having worked out the optimum pH concentration of ammonium salts, or of hydrochloric acid, temperature, period of standing, concentration of dye, etc., required for developing a maximum and constant intensity of lake and rapid decoloration of the excess dye, they were able to form a standard technique, and apply it to determine aluminium in biological material. For example, they found the optimum pH to be 4·5, and not more than 5·0.

They compared the colour of the lake formed from a material of unknown aluminium content with the lake made from various aluminium standard lakes in a way similar to later workers such as Cox and his colleagues. They obtained the best results when the concentration of aluminium standard and the aluminium in the sample were closest in value. Taking seventy-six samples, Winter and Bird [26] found aluminium in all. Four

samples were very carefully and specially prepared against contamination from adhering soil by removing the external surface altogether. Aluminium was found in all of these. The method of treatment of the others was to prepare the plants as if for food preparation. That is, they were washed with water and cleaned with a brush. In the case of roots, they were scraped with a knife and washed. Whatever figures were obtained would therefore correspond to practical conditions. All reagents had controls done on them for aluminium content. Their results are tabulated later on. Underhill, Peterman, Gross and Krause [24], in 1929, used Atack's method as developed by Underhill and Peterman [23], for two lines of research. Their method was nearly as sensitive as the aluminon-lake. Their first investigation was on the occurrence of aluminium in human liver and kidneys (the results of which are given above with Myers'), and the second on the aluminium content of fresh foods, in which they found definite amounts generally. Their results are tabulated later with those of other investigators using reliable methods. Later work has been done by Bertrand and Levy [27] (1931) and by Lehmann [28] (1929-31). The former used an elaborate gravimetric method without pH control, and the latter adopted the hydroxyquinoline method. In view of the drawbacks of both methods in handling organic material containing much calcium, as pointed out by Gwyer and Pullen, etc., their results will be omitted from consideration, although they largely bear out the results obtained by the previous workers and also those of the Mellon Institute.

The latest work includes that of Beal and his colleagues [3] described above and completed in April, 1932, and of Lampitt and Sylvester [12] published in July of that year. A table of a few findings follows. They are of course not in all cases strictly comparable, as some represent figures for the food plus the dressings used in cooking, while the others are calculated on the fresh tissue. The figures represent parts per million of aluminium.

Food	Underhill *et al.*, 1929 Raw material	Winter and Bird, 1929 Raw material	Cox *et al.*, 1930 Raw material	Beal *et al.*, 1932	Lampitt and Syl., 1932	Gwyer and P., 1932 Raw material
				As cooked with dressings		
Milk	13·5	—	0·07	—	0·4	0·8
Apples	0·47	1·1	—	0·28	2·0	—
Potatoes (peeled) ..	9·7 (3 to 17·6)	2·2	—	0·55	2·0	—
Beef	5·0	13·9	—	0·64	—	—
Beets	4·8	2·8 (1·9 to 3·7)	—	0·58	—	—
Eggs	1·7	—	—	—	—	—
Beans, green string ..	6·3	5·0	—	0·91	—	—
Cabbage	—	2·3	—	0·37	—	—
Tomato	—	—	—	0·13	1·0	—
Lettuce (head) ..	11·8	12·4	—	—	—	—
Oranges	0·88	1·6	—	—	—	—
Orange marmalade ..	—	—	—	0·30	—	—
Prunes	—	6·5	—	4·60	—	—
Apricots	—	—	—	24·60	—	—
Peas	3·1	2·5	—	—	—	—

Winter and Bird's results for material from which the external surface was completely removed are as follows :—

Carrots	..	..	2·06 (as compared with 2·5)	
Apples	..	..	0·7 („ „ 1·1)	
Beets	..	..	0·9 („ „ 2·8)	(compare Beal, etc., 0·58)
Potatoes	..	..	0·84 („ „ 2·2)	(compare Beal, etc., 0·55)

It is clear that foods, whether considered in the state in which they would be used in careful preparation for cooking, or in a form where all extraneous matter is absent, do contain appreciable quantities of aluminium. The results of those who use the aluminon-lake method agree very well, and taking therefore the figures of Beal and his colleagues as a basis, it can be calculated that the food contribution of aluminium in a representative diet of 2 to 2·5 kilogrammes per diem, constitutes at least 7 milligrammes daily, or 3·5 parts per million. It has been shown above that—if the food is cooked in aluminium utensils—the total daily intake averages 12 milligrammes or 6 parts per million. Thus, the daily removal of aluminium amounts to no more than 5 milligrammes or 2·5 parts per million. The food, because of its normal content, contributes twenty per cent. more than is taken up from the aluminium utensils, and hence it is impossible to believe that these small amounts of aluminium could do any harm even if absorbed over long periods of time. As regards tap water, the normal content of this is variously recorded as 0·04 part per million (Winter and Bird) or 0·3 (Lampitt and Sylvester). The actual figures obtained will naturally depend on the locality from which the water is derived.

The above considerations applying to a normal diet, it is fair to ask whether a person using a diet low in phosphorus might not lose phosphorus by combination with even the small amounts of aluminium indicated. This is definitely negatived by the results of Dr. Taylor's diet experiments on men in 1914, where amounts of the order of 270 to 330 parts per million (540 and 660 milligrammes) were fed daily to the subjects for five days, and the fæces when examined proved to contain no aluminium phosphate. Later, in 1931, Cox, Dodds, Wigman and Murphy [29] fed large doses of soluble aluminium salts to animal subjects kept on low phosphorus diets. Phosphorus starvation took place only when the amounts of aluminium administered rose to 1,400 parts per million. We can confidently rule out the possibility of phosphorus starvation occurring through the use of aluminium vessels, even when the diet is low in phosphorus. With the question of alleged beneficial effects obtained by persons after giving up the use of aluminium vessels for household purposes this paper has little to do. Dr. Eric Pritchard [30], for example, states that he has had occasion to scrap such utensils, and that beneficial effects accrued in the case of infants under his charge as well as with dogs. He states that infants are very susceptible to effects of acute aluminium poisoning, and that symptoms do not arise in adults till after a long period of exposure, and then only in the case of specially sensitive individuals. Readers can find interesting data in the

discussion following Dr. Burn's paper read at the Society of Public Analysts in June, 1932. We are considering normal adults only, and so far as these are concerned Dr. Pritchard's remarks are in accord with the conclusions derived from a correlation of the chemical and physiological data outlined above. The evidence accumulated in this paper shows that aluminium vessels can be used for storing water, for use as water-bottles, for frying or otherwise cooking foodstuffs, for heating acid liquids or milk, without the absorption of harmful amounts of the metal.

SUMMARY.

(1) Readers are referred to a survey of the physiological data to be found in Dr. J. H. Burn's report of March, 1932.

(2) Owing to the widespread distribution of aluminium (it is next in order after oxygen and silicon), the interpretation of the physiology and chemistry of aluminium depend alike on the use of an accurate method of determining aluminium *quantitatively* in biological material.

(3) Various methods in use in the past are discussed, and it is shown that earlier experiments can be dismissed on the grounds of insensitivity or inaccuracy of the analytical methods, and the high degree of impurity of the metal vessels employed.

(4) The method which has had most favour after extensive critical examination depends on the formation of a lake with aluminium after carefully precipitating the aluminium with iron from a solution of the ash yielded by ignition at low heat, the iron being subsequently removed before lake-formation. The lake is compared colorimetrically with standards. As an illustration of the technical difficulties and the care used in surmounting them, the technique of Cox and his colleagues is given in some detail.

(5) This method was adopted by Beal and his colleagues when they cooked various foods in pyrex and in aluminium vessels by standard cooking methods.

(6) The results (which agree with the investigations of other workers such as Massach and von Fellenberg) show that the total amount of aluminium obtained when foods are cooked in aluminium vessels is twelve milligrammes per diem.

(7) The results of direct investigation in the U.S.A., in 1914, on three groups of human subjects show that amounts up to 200 milligrammes per diem can be absorbed over long periods without ill-effects, and that even 1,000 milligrammes per diem does no more than produce catharsis from the Glauber's salts caused by the interaction of the alum with baking powder.

(8) Hence, cooking in aluminium utensils removes daily quantities of aluminium which are minute in comparison with those which can be administered without harm to normal adults.

(9) The experiments of Beal and his collaborators also showed the amounts of aluminium contributed by the foods themselves, and these

agree substantially with the experiments on raw food materials carried out by Winter and Bird, and others. These daily quantities amounted to seven milligrammes.

The amount, therefore, of aluminium taken up from the utensils by the food, when a representative daily diet of two kilogrammes is ingested, is five milligrammes per diem.

(10) As the food contributes sixty per cent of the total aluminium taken up, it is legitimate to conclude that these small quantities of aluminium can have no ill-effect even if absorbed over the course of many years. This is confirmed by direct experiments on the retention of aluminium which is shown to be minute, and of a small maximal amount not exceeded however great the dose ingested.

(11) Tap water is shown to have no deleterious solvent action on aluminium.

(12) Aluminium is a normal constituent of human, animal and plant tissues. The accuracy of the spectrographic method is adversely criticized.

(13) In order to produce phosphorus starvation in persons using a low phosphorus diet, at least 1,400 parts per million or 700 milligrammes per diem must be administered. Thus phosphorus starvation is out of the question as a result of cooking with aluminium vessels, however poor in phosphorus the diet may be.

(14) Alleged cases of gastric trouble which cease with the disuse of aluminium utensils may be considered very exceptional.

(15) Aluminium utensils can be used for storing water, for use as water-bottles, for frying or boiling or otherwise cooking food-stuffs, for heating or holding acid liquids or milk, without absorption of harmful amounts of the metal.

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DOWN SOUTH.

By U. P. A.

(*Continued from p.* 48.)

III.—The Crossing.

The "Lord Goschen" lay alongside the quay, ready for sea.

Her sister, the "Lord Irwin," occupied the opposite berth.

This is all wrong. It leads to the supposition that those responsible for the christening of these unfortunate steamers were ignorant of the existence of Lady Goschen and Lady Irwin, or were devoid of any nautical sense.

On boarding the good ship "Empress of Epernay"—or Ephesus, or Evesham—pleasurable anticipation thrills you through and through; but if the same ship be named, say "Emperor of Eigg," embarkation fills you with nought but dire foreboding.

Lords and emperors are all very well for stage-coaches and locomotives, but they are quite out of place at sea.

It is not merely a matter of custom and prejudice: it is a thing affecting the honour and integrity of our island race.

If those responsible for the christening of ships were better versed in sea lore and tradition, we should hear less about the decline of our maritime supremacy.

The fact that the "Lord Goschen" carried us in safety and comfort across the treacherous waters has nothing to do with the case.

Who is the better fitted to negotiate Adam's Bridge; His Lordship or Her Ladyship?

No one except the sponsors of a male ship will fail correctly to answer that question.

Wooden ramps were raised at a steep angle to the level of the floor of the truck. The ramps must have been heavy, as their elevation occupied the energies of about forty coolies. The serang sang the solo line of a sea shanty and, at each heave, the men bellowed the refrain. The ramps were in position by the end of the third verse. The car was run out of the truck and down the ramps on to a loading platform, to the tune of "Bound for the Rio Grande," in Tamil. The squeaking and grunting of the brakes made a most effective accompaniment.

The platform was slung to a small hook at the end of a thin steel wire rope, the ship's winch rattled and roared, and up went the car dangling in mid-air like a flat-iron on the end of a frail cotton thread.

At such a moment it is little satisfaction to reflect that you are insured up to the hilt against all contingencies.

I remarked to the captain that we used a similar contraption for weighing the babies at the infant welfare centre in Poona. He assured me that the thin wire rope had a breaking strain of over 2½ tons. Georgina felt much relieved. "Of course I don't know whether the car weighs one or five tons," she said, "but I like the captain's face."

Then the passport officer compared our features with the alleged photographs of the same. His scrutiny was long and anxious. It was amusing to watch him register doubt and bewilderment. It was easy to read his thoughts. "Leg-pull, no doubt; but why does this friendly sahib and his smiling memsahib wish to deceive me? for it is certain that the two badmashes here represented are in no way related to the passport holders. Ah, well! no matter: I am a poor man. . . ." He stamped the documents and, with a weary, puzzled expression, handed them back to us. I felt that nothing was to be gained by trying to explain to him the vagaries of Your-Photo-While-You-Wait as practised in the Edgware Road.

Finally I was passed on to the customs officials who dealt with the car export certificate; and when they had asked all their questions, completed their examination and filled-up all their forms, I knew what a lunatic has to go through from the time he enters hospital for thirty-days' observation until he embarks as an exhausted invalid at Bombay. However, it is all very good for the paper-making industry.

From the skipper to the cabin-boy, the deck crew of the "Lord Goschen" is Indian. Hence, before we got under way, the bell rang in a loud irregular manner for three minutes, and the siren emitted eleven ear-splitting blasts. In spite of this, Georgina, with her usual twenty-four-hour consistency, still asserted that she liked the captain's face.

Prior to this trip, Café and Noir had never seen a ship, or even the deep blue sea. They watched everything with open-eyed interest, but man rather than nature seemed to impress them the more—and, in particular, one man. This man belonged to a type of which Café and Noir had had no previous experience. He was a foreigner in a hilariously bibulous state; but his nationality remained obscure, as all his utterances consisted of repetitions of the one sentence—"Boy! anozzer of zee sāāme." He was travelling with three or four friends who tried to ignore him; but the more they attempted to freeze him, the more affectionate did he become He was a jolly little buffer and wonderfully adroit, for, in spite of his paretic inco-ordination, he never spilled a drop. To judge from his thrilling acrobatics, he was probably under the delusion that "Lord Goschen" was battling her way through a heavy sea. No doubt, in years to come, this funny little man will tell his grandchildren how he crossed Adam's Bridge in the teeth of a frightful gale.

At times this particular passage is very unpleasant. Usually it occupies about two hours: distance, 22 miles; but on one occasion last year the steamer was forced to remain at sea for 36 hours. As the steward's store

only supplies tea, biscuits and drinks, and as there is practically no saloon accommodation, the passengers had a very bad time.

At sunset the Mussulman sailors said prayers on the fo'c'sle head. Half an hour later we arrived at Talai Manaar. Here, the man who heaves the light line attached to the mooring warps made a bad shot. However, this was of no consequence : one of the crew, towing a line, dived overboard and swam to the quayside. Soon the ship was moored, the gangway lashed and the car slung ashore.

IV.—Though Every Prospect Pleases. . . .

Reference to the dictionary will show that "vile" means "abominably bad." Although the word rhymes well with "isle," surely there is no more justification for applying it to the inhabitants of Ceylon than to the inhabitants of any other small island. No doubt some of the Sinhalese—quite a lot, in fact—are vile ; but so, too, are appreciable numbers of Channel Islanders, Manxmen and Japs. Besides, there are some equally good and less uncharitable rhymes, such as wile, smile or bile.

What though the salt sea breezes
Blow wet o'er Erin's isle
Though every prospect pleases
And man is full of guile.

Although I have not been able to consult "Outward Bound," I think he would agree that the above is as sound, poetically, as the good Bishop Heber's composition. Also, it is more truthful and has less of the Old Testament bite about it.

Having seen a fair amount of The East, I often feel, on Mission Sunday, that we are rather hard on the idolatrous heathen. There is good in the worst of us and bad in the best of us. To label a whole race, without qualification, as abominably bad is to carry evangelical zeal so far that even poetical licence cannot excuse the lapse.

Georgina hurried off to secure a coupé.

It is curious how every Englishwoman in India cherishes the delusion that every train is composed solely of coupés ; or alternatively, that if there is a train with only one coupé, that coupé indubitably belongs to her. Often it is sad to observe the lengths to which a woman will go in order to uphold this alleged monopoly; but it is also comforting to feel that you are the husband of a wife who is certain to peg out her claim to the one and only coupé, e'en though the heavens fall : it allows you to look after the baggage in a quiet, dignified manner.

In due course I satisfied the customs, passport, police, health and railway officials, and once more entrained the car. It was very dark, and the quay was badly lighted, but eventually I found Georgina and "Anozzer of zee sāāme" in animated conversation. The little foreigner was trying to

explain that it gave him the greatest pleasure imaginable to hand over the coupé. Georgina was trying to impress on him the fact that the coupé never was his to hand over.

"Madam, it is yours."

"Certainly ——"

"Wiss alla my 'eart."

"With all my right to it, you mean."

"No, madam (*hic*) zare is no quesshun of right or wrong. I giff you zee coupé because (*hic*) I am shentleman."

The little man raised his hat. Georgina slammed the door, violently. The little man lost his centre of gravity, swayed, and bumped into me instead of falling into the dock. I righted him. "Monsieur," he said, "your wife she is (*hic*) mos' charming läädy." The darkness swallowed him up, but still I could hear him repeat "Mos' charming."

We found ourselves in a British corridor train. The doors were sliding ones; the cushions were upholstered in heavy tapestry; the woodwork was costly, beautifully finished and highly polished; the metal fittings were of the best, and gleamed fresh and bright in the light of the lamps. The saloon, dinner, and the table service and appointments made one think of the "Flying Scotsman." The din, dust, and general discomfort of the G.I.P. were but dimly remembered as inflictions of a long-buried past. We shook ourselves into realizing that we were not on the threshold of six months' leave, U.K.; that this was Talai Manaar, Ceylon, and not Dover, England.

The appearance of Café and Noir dispelled all illusions on that point. But this British train was not the only thing in Ceylon which transported us in spirit from East to West; which made us impatient of India and hunger for the homeland. In this little island there is an atmosphere, and a thousand things tangible which are in harmony with the Anglo-Saxon point of view. The British colonist has made his impress on the heart of Ceylon; comparatively speaking, he has hardly even scratched the skin of India. Café and Noir struggled with a window. The window refused to go up because it was constructed, English fashion, to let down. I lowered it. "Baith-jao!" I commanded. My two servitors squatted on all fours on the seat, facing a notice to the effect that "passengers are requested not to put their feet on, etc." I left them to it.

Talai Manaar is joined to Manaar by a narrow spit of sand eighteen miles in length. This spit is strewn with stones and dotted with rocks, stunted brushwood and clumps of strong sea grasses. It is traversed by a rough cart track as well as by the railroad. Last year one of my own officers—a cheerful and muscular young man—detrained at Talai Manaar and did the journey by road. After many hours he arrived at Manaar tired, but still cheerful. It was a notable feat, because it was done in bad weather. Apparently this blazer of trails (I repeat—one of my own

officers) sat at the wheel with the engine in low gear most of the time, while his wife went ahead clearing boulders off the track and filling up the holes with brushwood and rushes.

When this tale was told to Georgina, she pointedly reminded me that steering is her speciality and my weakness. I asked her, plaintively, if she thought I was to be relied on as a pebble pusher and bush whacker. She laughed. I decided that, when the time came, we should patronize the railway—and we did.

We arrived at Manaar shortly after 10 p.m. The truck containing the car was shunted into a siding, and we prepared to walk to the travellers' bungalow, distant two miles. It was a hot, steamy night and we were a-weary. It was therefore with heartfelt gratitude that we accepted a lift in a luxurious saloon car the property of the local Member of Legislative Council. As a rule there is little love lost between the soldier and the politician; but Georgina and I will ever hold in loving memory the Member for Manaar.

On arrival in Ceylon the motorist from India is astonished and overjoyed to find that nearly all the roads have excellent tarmac surfaces, and that the resthouses are run after the manner of small hotels. Each resthouse has a permanent staff, including a cook, and is fully furnished: that is to say with bedding, linen, cutlery, china, glass and so forth, in addition to the usual tables and chairs. Meals can be had at any time and, as a rule, the standard of cooking is quite good. The traveller cannot be "done," for a printed tariff lays down the cost of everything in detail. The charges vary in accordance with the district and the class of resthouse; they range (inclusive charge for twenty-four hours) from Rs. 6 to Rs. 12½. Thus, at Manaar resthouse—rather a poor one—we paid Rs. 6½ each; at Puttalam—an excellent place—Rs. 6¾; and at Negombo, where the resthouse is new and almost luxurious, Rs. 7¼. The highest charges are met with in the hill districts of the Central Provinces; at Nuwara Eliya, Rs. 9¼, and at Horton Plains, Rs. 12½.

That alone is calculated to turn the Indian motorist green with envy, but, as he glides over the dustless, glassy road surfaces and thinks of his journeys in Hindustan, his hue changes from emerald to a rich royal purple.

The spit—or, to be more exact, the island—of Manaar is bleak, flat and unattractive. Yet in the old days it was a great centre for seaborne Mohammedan commerce, the threads of which stretched to Arabia, the Mediterranean and as far as the west coast of Spain. But now, all that remains of the once busy port is an old and picturesque Dutch fort in a good state of preservation. This fort bears a strong family resemblance to the old seaward Dutch forts of the Cape.

On the morning of March 14, we detrained the car, crossed a rough and narrow causeway, two miles in length, which joins Manaar to the main island, and soon were speeding over the tarmac. However, we soon

learned that "speeding" in Ceylon is a risky business for, although the surface is tempting, the roads are narrow, winding and often very steeply graded. In addition to this, the drivers in Ceylon are the worst in Asia, Africa or Europe. If there are any worse in America or Australia, then I never wish to visit either of these continents. The Ceylon A.A. does what it can in the way of "Safety First" propaganda; but the only way in which to check reckless driving in Ceylon would be to institute drum-head courts-martial, empowered to inflict a minimum penalty of death on brown and white offenders alike.

Execution should take the form of burning in petrol; or—if that be considered too expensive—of crushing under the wheels of a solid-tyred 3-ton lorry.

I used to think that Georgina at the wheel was none too safe; but, since motoring in Ceylon, I have altered that opinion.

Fifty miles of varied woodland scenery brought us to Medawachchiya, where we had a lunch of the "high tea" order, in a good and pleasantly situated resthouse.

Eighteen miles south of Medawachchiya lies the ruined city of Anuradhapura. This is the oldest, biggest and most famous of the three "buried cities" of Ceylon. All three are situated in the North-Central Province. Anuradhapura was founded about 437 B.C. and for 1,400 years remained the capital of the island. Mihintale is reputed to have been raised about 246 B.C. to the honour of Buddha, following the conversion of the king and his subjects to Buddhism by Mahinda, the son of Asaka. Compared with these, Polonnaruwa is an upstart. It was founded in the tenth century, when Richard I was King of England; but in 1225 it was sacked by a marauding chieftain. So thoroughly did the despoiler do his work, that the city never revived, and the site has remained deserted to this day.

Anuradhapura is a big place. It is believed that, in its prime, it covered an area of 256 square miles. To-day the ruins of its six great dagabas, with their attached buildings, are wonderful to behold. The highest is 240 feet, but it is said that, in its original state, this mound-building was carried to a height of 405 feet—or 50 feet higher than the dome of St. Paul's.

Faut d'la vertu, pas trop n'en faut,
L'excès en tout est un défaut.

And again,

. . . *l'homme dit ce qu'il sait, la femme dit ce qui plait.*

Hence, I frankly avow that I know nothing at all about these things, and Georgina yawns and says that, anyway, she prefers them to nasty old Epstein. But then, neither of us belongs to that objectionable class of scientists, the "A" class: the class comprising the anatomists, astronomers, astrologers, antiquarians and archæologists.

The members of this class plague us from long before we are born till long after we are dead, and nothing we, individually, can do, will stop their nefarious activities.

They turn on us the roentgen rays to determine whether we be occipito-posterior, a breech or (great excitement) twins. They appear at Anuradhapura to transform our wonder and delight into vulgar, vacuous curiosity. They dig us out of our age-long graves, and exhibit our tooth-brushes and sock-suspenders to a new generation just as scared and ignorant as we used to be.

They are universal and eternal.

What is happening in Patagonia to-day? Thousands of so-called slaves who, in the bygone happy days, were in receipt of free quarters, rations and clothing, are now wandering naked, starving and homeless. This has been done in the sacred name of Liberty: slavery must be abolished.

What do we see in China? Thousands who once upon a time were content to earn an honest penny by selling dressing-gowns and dinner mats, are now holding Englishwomen to ransom for a few pounds of opium. No matter what the normal habits of these poor Chinamen may be, opium must be abolished.

And now, look at Scotland. Here is a whole nation suddenly out for Home Rule, although contemporary history does not furnish many encouraging examples of that particular political state. Have the Scots temporarily lost their traditional stability and canniness? No, they have not. They have merely realized what no one else yet seems to have discovered—that the League of Nations has been captured by the "A" class of scientists, headed by the Super-Altruists and the Sweeping Abolitionists. The Scots say: "The sturdy Patagonians are dying like flies because their yokes have been abolished. The placid Chinese have become a nation of ferocious brigands because their daily dollop of opium has been abolished. Well—and before it is too late—hands off the whisky!"

Undoubtedly this is a serious matter, for, without the aid of Scottish taxation, how can England continue her support of the League on the present financial basis? It is all very complicated; but at present it would appear that, if whisky is to be saved, then some of the other nations as well as ours will have to contribute towards the League's expenses—which is unthinkable.

Meditating thus amidst the ruins of Anuradhapura, it is clear that we stand at the cross-roads, that we are face to face with a crisis, that we have reached an impasse or what not. But of this one thing we may be sure: that if only the members of the "A" class of scientists would act like men and commit suicide, we should be freed from this infernal inferiority complex and once again be able to sing "Britannia Rules the Waves" without any reservations whatever.

Yes, it is all very complicated; and alas! these ——[1] "A"s are not altruistic enough to abolish themselves.

Mention of cross-roads reminds me that, if you enter Ceylon from the north, Anuradhapura is a good starting point for any part of the island. From this place main motor roads run north to Jaffna, east to Trincomalee, south to Kandy and Nuwara Eliya, and south-west to the coastal route for Colombo.

As Georgina and I dislike touring to programme, we found it difficult—in the presence of so many diverging highways—to decide where to go. Jaffna seemed attractive. It is the palmyra district; and nowhere in Ceylon is the Dutch influence more marked. By chance, the concluding sentence in the A.A. guidebook caught my eye: ". . . resthouses in the Jaffna Peninsula have no liquor licences." I kept quiet about that and hastily looked up "Trincomalee." Georgina agreed that that seemed to be a charming place: naval station, magnificent harbour, little islands for little picnics and the Swami Rock, 400 feet high. Here there is a monument to Francina van Rhede, the daughter of a Dutch official who, tradition says, became engaged to an officer. When he sailed away she flung herself into the sea. Georgina was touched by poor little Francina's story. So was I; and so, I hope, are you. Then Georgina thought that such places as Dutch Point, Fort Frederick and Ostemburg Point must be as pleasant as they sounded.

I felt we were making good progress. Nothing in the world attracts me as much as a seaport, big or small, old or new. On an occasion, long ago, I fell over a quayside into the harbour of a thriving fishing village. The tide was out, and the harbour bottom was covered by six inches of salt water. The surface of the water was twelve feet below quay level, and beneath it there was a deep layer of soft stuff—thirty per cent mud and seventy per cent herring guts in different stages of decomposition, mostly advanced. They threw me a rope, hauled me out and stood afar off pinching their noses and imploring me to go away. However, I enjoyed it all. Not all the stenches in the universe could rob me of the pleasures of such an experience. I wondered if Trincomalee would revive for me the maritime joys of youth.

Of course I do believe that cleanliness is next to godliness; but to appreciate a seaport properly, it is necessary to forget that.

Georgina's leaning towards Trincomalee was a fine tribute to her heart. It could only be explained by the fact that the tragic love story had diverted her attention from the watery element; for, if Georgina hates anything, it is the sea. Indeed she loathes it, and all that pertains to it, with an intense loathing.

There was a pause.

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Imagine my mortification and surprise when Georgina said: "Poor wretched Francina! But Trincomalee is off for the time being; without a doubt we cannot go there." I noticed that she was in a brown study and talking to herself. She continued: "We must make for Colombo as quickly as possible. *By hook or by crook I* MUST *get a hat fit to wear in decent society.*"

The car was headed south-westwards. We sped through miles of coconut plantations and past neat and clean villages clustered round big baroque Portuguese churches. In the old days, when these churches were built, the countryside must have been more populous, or the padres more optimistic, than is the case now.

From our Indian point of view, every prospect was pleasing and nobody seemed vile. At that time Ceylon was feeling the full force of the general depression; it was said that trade was stagnant and unemployment rife; but to our eyes everything appeared to be very advanced, orderly, prosperous and clean. The people looked happy, well fed, housed and clothed, and the women, garbed like the "mammies" of the Southern States of America, laughed and chattered in a way which one seldom observes in Hindustan: a good index of a country's state of civilization. There were, however, no hat shops.

On this run some of the forests closely resemble the Mysore jungles; they contain a great variety of trees and dense clumps of bamboos. We drove through myriads of butterflies, thick as flakes in a snowstorm.

An hour before sunset we arrived at the resthouse at Puttalam, 116 miles from Manaar.

Puttalam stands on the shores of a navigable sea loch, about twelve miles broad by forty long. It is here that Wijeyo, first King of Ceylon, is supposed to have landed in 543 B.C.

From Puttalam the coast road runs south via Chilaw (32 m.) and Negombo (59 m.) to Colombo (82 m.) Chilaw is the capital of the district and the centre of the coconut industry. At Negombo there is an old Dutch fort and a very fine resthouse much patronized by week-enders.

We reached the outskirts of Colombo at 12.30 p.m. on March 15, and at 1 p.m. drove up to the main entrance of the Galle Face Hotel. Even if you have never been in Colombo, it is certain that you have heard of the Galle Face on the promenade and the Grand Oriental at the docks. It is said that, if you visit the latter, you are *bound* to meet somebody you know; and the management is famed for its "Pilsner-Urquell" on draught. The former is not so chummy: it is "situated in the coolest part of Colombo" and possesses a new open-air swimming pool. It is an austere, cosmopolitan caravanserai and, in keeping with all institutions of that type, its coolness and detachment extend to the manner in which it receives and entertains its nomadic and plutocratic guests.

The magnificent, massive, modern hotel—ugh! The more glitter the

less soul; the bigger the staff the worse its manners; the farther the personality of the manager recedes, the more insignificant are you made to feel. It might have been better if Georgina and I had arrived in full evening dress and mounted on elephants; but, as we only came prepared to abide by the rules of the hotel and to pay its bill, we had not thought of that. A Field-Marshal in pre-War review order glared at us. (He was afterwards identified as the Chief of All the Hall Porters.) "What the devil are you staring at," I asked—not without considerable trepidation. "At my hat" Georgina meekly ventured, and fled. But there is an exception to every rule; the little man in the lift was quite pleasant and polite. I tipped him.

During rush hours a lift attendant has neither time nor opportunity for anything but the work in hand; but in his more leisured moments he is, as a rule, a human being, kindly, simple and sympathetic. He can always produce for you yesterday's paper from under the seat, and he hates the sight of the Chief of All the Hall Porters. The latter is the only hotel servant who is allowed to travel in the guest's lift, and he drives the poor little man to distraction by gliding up to the sixth floor and down to the basement twenty times a day, for no other reason than to bully the little fellow and flaunt his own importance. If I were a lift attendant, I'd slam the gate on the senior hall porter when he was half in and half out of the cage; and if that did not finish him for good and all, I'd start for the sixth floor on top gear. That would do it.

Having had access recently to three good libraries, I find there is much literature on the subject of Ceylon, and that Colombo receives marked attention therein. It is therefore quite unnecessary to describe the place in the orthodox way: a few observations which seem to have escaped the notice of others will suffice.

Standing in the middle of one of the principal thoroughfares there is a real lighthouse, by which the inhabitants are enabled to navigate their several ways home on a wet night.

In another main street you will notice that the two sides are very different. One side resembles Oxford Street, W., and the pavement in front of the shops is crowded with women. The other side is like a street in Port Said, and thronged with brown and yellow shopkeepers and their touts, hawkers, loafers, and bluejackets and other seafaring men. Neither here nor elsewhere do you ever see a soldier. The barracks in Colombo are on the promenade, facing the sea. They are conspicuous, and seem to be commodious; but their inhabitants must be busy indoors, or sick, or at the cinema; or it may be that they are on permanent pass, with permission to wear mufti. However, there must be *one* soldier at least, in Colombo: the one who furnishes our CORPS NEWS AND GAZETTE with "Notes from Ceylon."

(*To be continued.*)

Editorial.

THE REPORT OF THE COMMITTEE ON THE MEDICAL BRANCHES OF THE DEFENCE SERVICES.

THIS Committee was set up by a Treasury Minute of May 22, 1930, to investigate the causes of the shortage of officers in the Medical Branches of the Defence Services, and to report by what means the situation could be remedied. The presentation of the Report has been delayed by the financial crisis in the autumn of 1931, which precluded for a time any definite conclusions as to the financial attractions that might be offered to enable the Services to compete effectively with civil medical employment.

An analysis of the evidence placed before the Committee led to the conclusion that the main causes of the shortage of recruits were: (*a*) lack of professional opportunity; (*b*) lack of economic attraction; and (*c*) inadequate status.

The allegation that a medical man in the Services has no reasonable opportunity of practising his profession has often been put forward; this view seems to be held in an extreme form by medical students, who have no direct knowledge of the work in the Services, and in a more moderate form by senior representatives of the schools. The Committee realized that it was of the first importance to correct authoritatively this impression of lack of professional opportunity so far as it proved to be wrong, and so far as it proved to be right to remove the professional disabilities found to exist.

Two members of the Committee, Professor Gask and Dr. Gray, whose conclusions carry great weight in the medical schools, were asked to investigate the matter and assess the professional opportunity which exists in the Services as at present organized.

They reached the conclusion that as regards opportunity of a specialist career the Services offer good scope in medicine, surgery and pathology. In the Army the staff appointments in hygiene give work comparable to that of a Medical Officer of Health in civil life. Unfortunately the period during which such special work can be practised is limited in the Army to about nine to twelve years, though the exceptional man may continue to be employed in his special subject when promoted to the rank of Colonel or Major General. Officers attached to the major hospitals in all three Services have good opportunity for both specialist and general professional work, and in the Army the families' hospitals provide

good professional work in gynæcology and obstetrics. In small stations the clinical work is much less than that usually expected in civil life and the balance of the work consists mainly in recruiting, inspections, etc.

In accepting the conclusions of Professor Gask and Dr. Gray the Committee states that they show that as regards important classes of employment in the medical services, the opinion they have found to exist among medical students is definitely incorrect. As regards other classes of employment, however, they show that improvement in professional opportunity is very desirable.

When estimating the financial value of a career it is not sufficient to consider the scale of emoluments: it is necessary to take into account the length of the career, the average age at which promotion takes place and the proportion of officers that can be promoted from rank to rank. Amenities of location, frequency of moves and separation from family must also be considered.

Speaking broadly, the Committee found that the present career goes to Lieutenant-Colonel for about half the officers, and to Colonel for about half of the Lieutenant-Colonels. An average age for promotion to Lieutenant-Colonel is 48 years and to Colonel 53 years.

The Committee compared the financial advantages of a career in the Services with that in the Colonial Medical Services, the Sudan Medical Service and under Local Authorities, and found there was no marked economic advantage, one way or the other, as between the career they offer and that provided by the fighting Services.

The information available did not show that the average yearly earnings of general practitioners are greater than the emoluments of the Fighting Services. But the earnings of a general practitioner rise more rapidly to a substantial income than do those of the officer, and his career is considerably longer. But these advantages are more than balanced by the fact that when the practitioner retires his income ceases altogether, and to obtain an annuity equal to a Service pension the practitioner must set aside a considerable sum yearly from his income.

Inadequate status is not thought to be a serious source of dissatisfaction in the Army at the present day. Certain differentiations as regards uniform are considered to be undesirable as being sources of avoidable grievances. While some of the functions of a medical officer differ from those of a combatant officer, it is thought that he is entitled to equality of status with the latter.

The Committee considers that a distinction must be drawn between difference of status and difference of function. "The function of the medical officer is of vital importance to military operations, and wars have been lost through this fact being forgotten during periods of peace. The function of the medical branch is, however, of its nature ancillary to the main offensive purpose of a fighting force. There is danger that differentiations which are inevitable and in no way derogatory as flowing from this

fact may be mistaken as an attempt to impose an avoidable and undesirable inferiority of status."

The cost of the Medical Services of the Army is £2,188,200, this representing more than five per cent of the total of Army votes, and in the present financial condition of the country any increase in the cost of the Medical Services could only be provided within the present total of Army votes by reductions in the fighting strength of the Army. The Committee, therefore, made it a condition of the solution of the problem that the normal cost of the Medical Services shall not be increased by their recommendations.

The solution involved a reorganization of the Services on lines designed to improve materially the professional opportunity which the career offers and to add substantially to its economic advantages.

The Committee considers that these ends can be attained by a reduction in permanent establishment, which is believed to be both possible and desirable. In this way an increase in the medical work available can be achieved and the financial value of the career improved by better opportunities of promotion.

A total establishment of 750 medical officers is contemplated as compared with an establishment of 864 in force when the inquiry was commenced. A part of this reduction has already been effected in the Indian establishment, but the greatest reduction must fall on the British establishment, and is rendered possible by carrying further the elimination of posts that do not provide an adequate amount of professional work.

In the establishment suggested there will be 119 lieutenant-colonels, 49 colonels and 6 major-generals, an increase of 46 lieutenant-colonels and 21 colonels. This up-grading is considered to be justified by the fact that the present grading in the higher posts is not in accord with the responsibilities the posts carry.

It is also suggested that the average ages of promotion should be as follows, the age of entry being taken to be 25 :—

To captain 26, to major 35, to lieutenant-colonel 42, to colonel 50.

Promotion to lieutenant-colonel and to colonel is by selection within establishment, but this should be designed on the basis of achieving promotion to these ranks after seventeen and twenty-five years' service respectively. It is contemplated that of the officers remaining in the Service till the ages of promotion to lieutenant-colonel and colonel all shall be promoted to the former rank and a large majority (about seventy-five per cent) to the latter rank. These opportunities of promotion are contingent upon the limitation of the yearly entry to permanent commissions, so that the numbers remaining in service at the ages in which promotion should take place do not exceed the opportunities for promotion which that higher establishment offers. A number of non-permanent officers will, therefore, have to be carried in the Service and the permanent entry will have to be adjusted from time to time in the light of experience

of the rate of wastage so as to ensure to entrants the expectations of promotion just laid down.

No changes are suggested in the present ages of compulsory retirement, but as many officers will reach the rank of Colonel, the normal career will be longer than at present.

The Committee suggests that the number of specialist posts on the British establishment should be increased from 113 to 155, and a standard rate of 5s. a day should be introduced; this should be issuable to all officers in charge of hospitals of fifty beds or over, and also to officers in charge of medical and surgical divisions of large hospitals.

The Committee recommends that all officers should be entered in the first instance for a period of five years' service and from them the numbers required for permanent commissions should be chosen. Officers not selected for, or not desiring permanent commissions, should be transferred to the Reserve at the end of five years' service, and should be eligible for a gratuity of £1,000. The Reserve formed of short service officers will therefore be composed of men experienced in the work of the Service and fitted to take their place in the war organization immediately on mobilization. In size this Reserve will amount to more than twice the reduction proposed to be effected in the regular establishment. The Committee considers that the position of the R.A.M.C. on mobilization will be materially strengthened by the proposed reorganization.

It is calculated that approximately 260 out of the total of 380 overseas posts will be filled by officers in their first six years of service. Only about 120 overseas posts will fall to be filled by the officers, approximately 400 in number, who have over six years' service; this will give great relief to the older officers to whom overseas service is often a burden.

The financial value of the proposed career terminating at the rank of Colonel would be as follows :—

	Age Groups.					
	25-29	30-34	35-39	40-44	45-49	50-56
	£	£	£	£	£	£
Proposed ..	541	767	957	1,157	1,327	1,412
Present ..	501	691	848	1,003	1,153	1,354

The greatest part of the financial improvement in the career is spread over the period of service between the ages of 35 and 50; it is during those years that an officer who marries relatively young feels the heaviest financial burden.

The effect of the proposed arrangements will be that about eighty per cent of the officers with seven to seventeen years' service will occupy specialist posts, and about twenty per cent other posts of professional character. About fifty-three per cent of the Lieutenant-Colonels and twenty-one per cent of the Colonels will have specialist employment. Work of a professional character will be available during the greater part of an officer's service below the rank of Colonel, i.e., normally up to the age of 50. In the rank of Colonel forty-two per cent of the posts are of this character, a

proportion more than double that prevailing in the Service as at present organized.

We are glad that the Committee has dispelled the old fetish that the only way to obtain promotion in the Medical Services is by holding administrative appointments.

The reorganization scheme is most ingenious and the Committee is to be congratulated on the professional and economic advantages which it offers.

There is little reference in the scheme to retired pay. In the old days, the privilege of retiring on £1 a day after twenty years' service was a great attraction. No doubt the privilege still remains, and perhaps it is not mentioned since a considerably larger proportion of officers will retire with a Colonel's pension and a considerably smaller proportion with a Lieutenant-Colonel's pension.

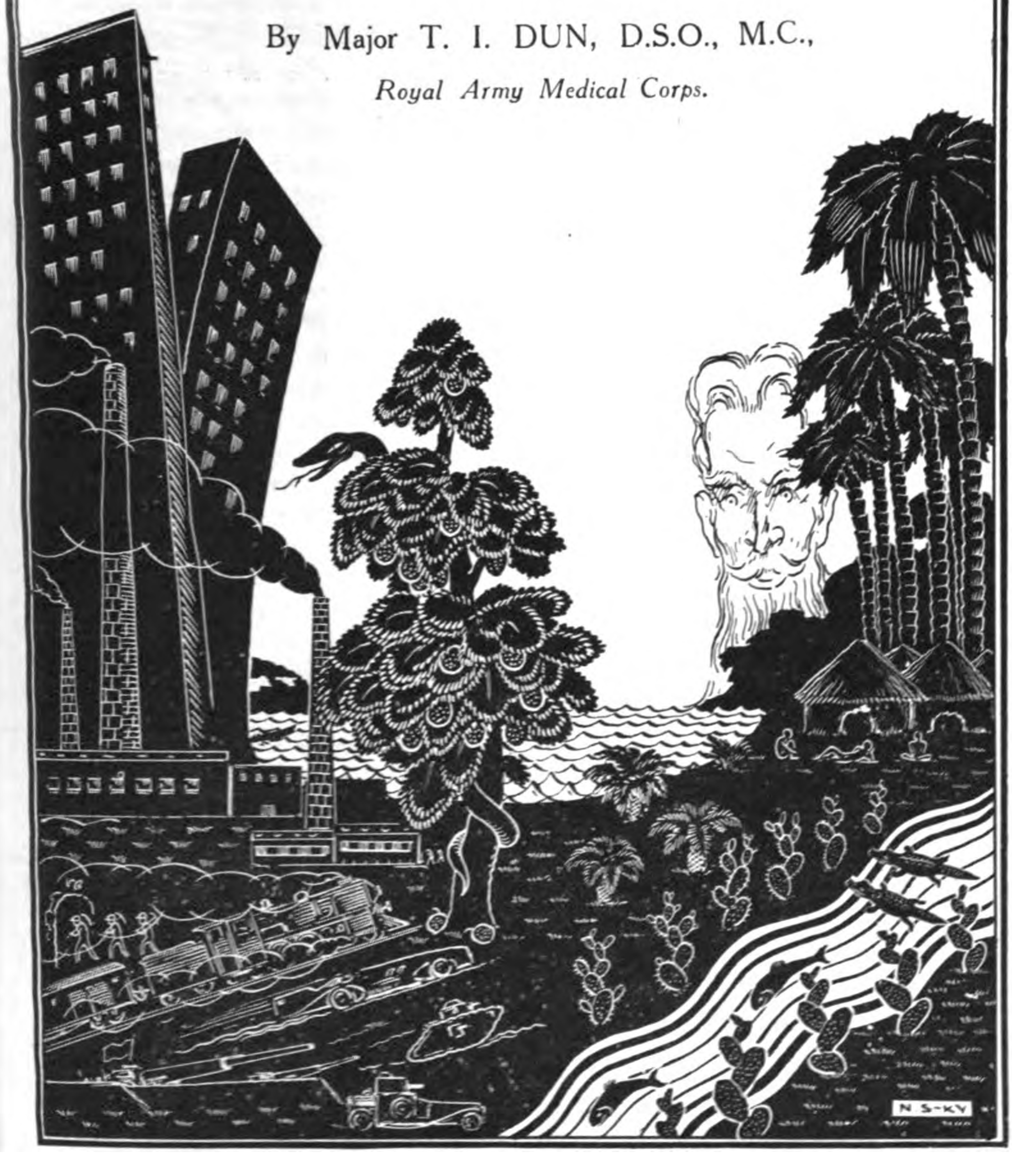
If lack of professional work has been the reason why medical students have not selected a Service career, as has been emphasized by the heads of the medical schools, that deterrent has now disappeared and it is only reasonable to expect that the heads of the medical schools and the leaders of the profession will do all in their power to dispel the erroneous conceptions of a Service career which have hitherto prevailed.

"FROM CAIRO TO SIWA."

Across the Libyan Desert with Armoured Cars.

By Major T. I. DUN, D.S.O., M.C.,

Royal Army Medical Corps.



"INTRIGUING."—Mr. George Bernard Shaw, after his world tour, is quoted as saying: "Civilized people are unhappy and anxious, uncivilized people are happy and care-free." One of the magnificent designs by N. Strekalowsky, from Major Dun's book.

THE ROMAN FORT AT MERSA MATRUH AND SPONGE FISHING FLEET. BY N. STREKALOWSKY.

"FROM CAIRO TO SIWA."

MAJOR DUN originally intended to write an account of the journey from Cairo to Siwa by the armoured cars of the 12th Lancers for the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, but as the story grew under his hands and the necessity for illustrations quite beyond our scope became apparent he enlarged the article into a remarkable book, to be published entirely by Egyptian printers. Field-Marshal Sir William Birdwood has written a foreword and some idea of the character of the book can be obtained from a cursory glance through the prospectus which has just been issued. Many of the illustrations are magnificent and the most remarkable are those by N. Strekalowsky, who has also illuminated each page of the narrative. The author has designed the covers, and many other artists, as well as students of the School of Fine Art, Egypt, have contributed drawings.

This book would make an unusual and most attractive present to any Mess.

The book is divided into four parts. The first is a narrative of the journey from Cairo to Siwa and back; the second is a short history of the customs and superstitions of the Siwa Oasis and adjacent Libyan Desert. Then come photographic pages and lastly a map drawn by Mr. J. H. Rowntree, supplementing the sketch map in the text.

The armoured cars took the northern route across the Wadi Matrun desert to Burg el Arab, next marched to Mersa Matruh on the coast, then on to Sollum and south to Siwa across the desert and the sea of stones. The return journey was from Siwa direct to Mersa Matruh and then to Cairo by the route previously followed.

Major Dun writes: "One's first ride outside an armoured car standing at the base of the turret and above the well, was a mixed joy. The Giant Racer at Wembley was as nothing to this. For one short moment when we met a bump as we dashed along, everything except my hands, which were clinging to the side of a slit in the top of the turret, left the vehicle. I admired the limpet-like tenacity and nonchalance of the serjeant by my side."

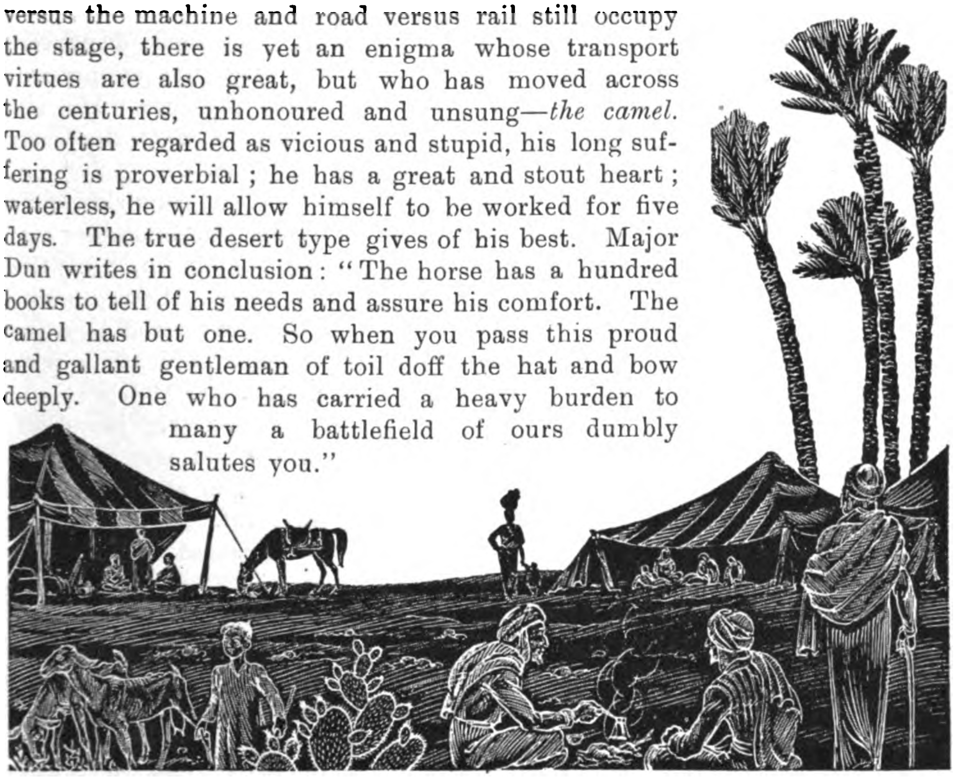
The great thing was to move forward as fast as possible. When a car stuck in a soft patch re-starting was done by placing two poles lengthwise on the ground. The end of each pole was pushed between the twin-tyres

of each rear wheel. When the engine was started the car ran along these rails on to rope and cane mats, which had been placed ahead.

When the cars crested the high hill above Mersa Matruh Major Dun writes: "We saw beneath us the peacock blue and green waters creaming on a beach of dazzling whiteness, from which stretches of sand ran far off into the western salt water lagoon. A gaily coloured Greek sponge fishing fleet was in the eastern harbour. The rocky forehead jutting into the sea on the eastern reaches was crowned with a crumbling fortress, a Roman stronghold of old. Here was a sight for desert-weary eyes. Surely an echo of the sea could be heard faintly across the years when that warrior host of Greece, wandering and almost without hope of reaching the sea, suddenly came on such a scene as this."

At the end of the narrative Major Dun pays a great tribute to the men. A beautiful page is dedicated to "the salt of the earth, whose fund of humour, doggedness and language we so admired in those past years and still find present, and who are steeped in the tradition of gallant deeds and chivalrous behaviour."

The performance of the machines over a difficult terrain was a matter for surprise. While methods of transport can tax the resourcefulness and ingenuity of the keenest intellect, and discussions on the horse versus the machine and road versus rail still occupy the stage, there is yet an enigma whose transport virtues are also great, but who has moved across the centuries, unhonoured and unsung—*the camel.* Too often regarded as vicious and stupid, his long suffering is proverbial; he has a great and stout heart; waterless, he will allow himself to be worked for five days. The true desert type gives of his best. Major Dun writes in conclusion: "The horse has a hundred books to tell of his needs and assure his comfort. The camel has but one. So when you pass this proud and gallant gentleman of toil doff the hat and bow deeply. One who has carried a heavy burden to many a battlefield of ours dumbly salutes you."



THE BEDOUIN CAMP IN THE LIBYAN DESERT. BY N. STREKALOWSKY.

Clinical and other Notes.

AN INTERESTING LIVER CASE.

By Major J. B. A. WIGMORE,
Royal Army Medical Corps.

THE case is one of acute yellow atrophy of the liver, occurring in a non-commissioned officer, aged 30, of ten years' service, whose medical history sheet showed no entry of interest other than amœbic dysentery, of twenty-six days' duration at Jubbulpore in 1929.

He was admitted to hospital with a history of headache and insomnia for three days, and pyrexia for the previous twenty-four hours. After admission his fever and symptoms quickly subsided. Blood slides were negative for malaria. Two days later he was seen to be slightly jaundiced and the following day he vomited profusely. The same night he became violently delirious, requiring restraint and morphia.

At examination next morning the symptoms, except for the normal temperature and slight jaundice, suggested the onset of cerebrospinal meningitis; the white cell count revealed a leucocytosis of 18,000, with polymorphonuclear leucocytes eighty-five per cent. The optic discs were seen to be intensely congested. The urine at this stage was suppressed. Lumbar puncture revealed a clear fluid not under pressure. He was removed to the Government Fever Hospital, where he died the same evening, a provisional diagnosis of septicæmia being made.

Examination of the cerebrospinal fluid showed a clear, colourless fluid and no pellicle on standing. Protein estimated by the proteinometer was 40 or 50 milligrammes per 100 cubic millimetres; globulin, nil. Cell count, 4 cells per cubic millimetre. Centrifugalized deposit showed scanty mononuclear cells and no organisms on staining. Culture proved negative.

As there seemed some doubt as to the actual cause of death a post-mortem examination was carried out the following day.

The body was well nourished but on the lean side. Skin jaundiced, but no petechial hæmorrhages were detected. The brain was removed, but except for some general adhesions of the dura to the skull appeared quite normal. The heart showed evidence of fatty infiltration, but no dilatation or hypertrophy. The myocardium appeared pale. The mitral valves showed a few old patches of granulation. The lungs showed adhesions to parietal pleura, but were otherwise normal.

The abdomen: no ascites or adhesions in the peritoneum; stomach and intestines appeared normal. Spleen: no enlargement or apparent softening. Kidneys: showed some congestion, otherwise normal. Liver: much diminished in size, especially the left lobe, with a wrinkled capsule and a flabby consistence, flattening out upon the table. Weight, thirty

ounces. No subserous hæmorrhages were detected. The cut surface showed a somewhat mottled appearance, mainly red in colour. A culture taken from the spleen was sterile.

An examination of a series of sections of the different pieces of liver has shown the following :—

(1) The liver capsule is markedly thickened and there is cirrhosis of a diffuse type associated with some thickening of the walls of the vessels.

(2) There is a generalized necrosis of the liver cells with no evidence of regeneration in any area examined, and few cells left at the periphery of the lobules. Kupfer's cells are obvious.

(3) There is some inflammation of the larger bile ducts with desquamation of the lining epithelium.

(4) The sections stained by the Levaditi method are negative for spirochætæ.

(5) There are no hæmorrhages, either subcapsular or in the substance of liver tissue.

The well-established cirrhosis of the liver makes the case interesting from an ætiological point of view.

Weil's disease was not suggested either by the clinical picture or by the appearance of the liver.

If there was a preceding acute infection there was no evidence of its nature. Possible causes of the underlying cirrhosis can only be conjectured.

There was no history of syphilis, and the microscopic picture does not suggest the adult type of liver cirrhosis.

The possibility of treatment by arseno-benzine derivations from an unauthorized source was considered. This might have accounted for the cirrhosis by a replacement fibrosis. There is nothing to suggest such a theory and chemical examination of the liver by the Marsh-benzoline method proved negative for arsenic.

There was no entry of previous hepatitis in the medical history sheet, and it does not seem to have complicated the amœbic dysentery referred to.

Inquiry elicited the fact that the patient had been a heavy beer drinker, but was not partial to spirits. The post-mortem examination showed no macroscopic evidence of the pathological picture of alcoholic excess.

The cause of the rapid necrosis of the liver cells was not elicited, but all authorities admit that there are still a certain number of such cases in which the cause must remain uncertain ; for example, Steihn and Hockett[1] record a similar case. It was considered that the rarity of the disease justified its being recorded.

I have to thank Lieutenant-Colonel G. F. Rugg, Royal Army Medical

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Steihn and Hockett. *Journal of the American Medical Association*, 1930, p. 1981.

Corps, the Officer Commanding, Citadel Military Hospital, Cairo, in which the case occurred, and Colonel J. T. Johnson, D.S.O., Deputy Director of Medical Services, the British Troops in Egypt, for permission to submit this article for publication.

A CASE OF MYOTONIA ATROPHICA.

By Captain M. R. BURKE,
Royal Army Medical Corps.

Pte. F., aged 22, service ten months and serving in a Highland Regiment, reported sick at the Regimental Medical Inspection Room, Kowloon, China, on April 4, 1930.

He stated that through no fault of his own he was often "checked" for being slow at his drill. He said that when doing arms drill, for example, his movements were slow, stiff, and awkward at first, but that this stiffness gradually wore off as the drill proceeded and that he was then able to carry on in a normal manner. He had noticed this peculiar stiffness for the past three years.

The man was asked to "shake hands" and the effect was very dramatic, for when he attempted to release his grip the slow relaxation of the flexors of the hand, so characteristic of this disease, was at once apparent and the hand temporarily assumed a claw-like appearance, till relaxation became complete. The time taken for complete relaxation of the grip was about ten seconds. The procedure of shaking hands was then continued, and it was observed that on repetition the relaxation of the grip improved, until finally it took place at a normal rate. He walked with a stiff gait which gradually wore off on continuing the movements. The flexors of the hand appeared to be atrophied, but not to any marked degree. No appreciable atrophy was noticed of the sternomastoids, face, anterior thigh muscles or the flexors of the ankles.

The knee-jerks were normal; abdominal and pupillary reflexes were slow; there was no nystagmus.

There were no signs of disease in any of the viscera.

There was no history of any nervous disease in the family.

The man was sent to hospital on May 19 with a provisional diagnosis of myotonia atrophica.

In hospital it was noticed that he experienced difficulty in relaxing certain muscles, particularly the flexors of the hands and the sternomastoids; the trunk muscles were not affected.

He complained of slight stiffness in the legs, wearing off after continued use, which made him feel unsteady on his legs. There was no pain in any of his muscles and no muscular atrophy could be discerned except in the small muscles of the hand. Electrical reactions were normal. Reflexes and cutaneous sensibility were all normal. The eyes were normal.

Nothing abnormal was found in the urine and fæces. The Wassermann reaction was negative. There was no evidence of neurasthenia or hysteria.

The case was seen by the Honorary Consultant Physician, Professor W. I. Gerrard, O.B.E., M.R.C.P., M.D., who confirmed the diagnosis as a case of myotonia atrophica.

Treatment was carried out on general lines, tonics, liberal diet, etc. Massage was tried, but it was discontinued as it was found to be of no benefit.

Whilst in hospital the patient's condition remained unchanged and it was decided eventually to invalid him home.

Comment.—Myotonia atrophica, although a very rare disease, is of particular interest to the Services on account of the age incidence of onset, i.e., 20 to 30 years, and because it is a condition which might easily be overlooked in a recruit.

Unless the soldier happens to report sick, as in this case, for being slow and awkward in his drill, it might be quite possible for him to serve for a considerable period before the disease would be detected, and during that time he might have disciplinary action taken against him on account of bad drill, awkward gait, etc., when in reality it would be no fault of his.

Myotonia atrophica is a disease which is intermediate in type between Thomsen's disease and the muscular dystrophies, but the latter all commence in childhood and are, therefore unlikely to be met with in the adult soldier.

In conclusion the thanks of the writer are due to Major L. M. Rowlette, D.S.O., M.C., for so kindly furnishing a report on the patient after he had been admitted to hospital, and to Colonel C. D. Myles, O.B.E., A.D.M.S. China Command, for permission to forward these notes for publication.

Echoes of the Past.

THE ARMY MEDICAL SERVICES AT HOME AND ABROAD, 1803-1808.

By Lieutenant-Colonel G. A. KEMPTHORNE, D.S.O.,
Royal Army Medical Corps (R.P.).

(*Continued from p.* 151.)

Ceylon, 1803-1805.

One of the least attractive military stations at this period was the Island of Ceylon where from 1803 to 1805 the troops were engaged in a series of harassing and unprofitable operations.

Since 1796, when the Dutch settlements on the coast were captured, the Company's troops had occupied Colombo and Trincomalee, but had not penetrated to the centre of the island, which remained under the rule of the King of Kandy. At the Peace of Amiens Ceylon was made a Crown

Colony. In 1803, when Governor North decided on the occupation of the capital, the garrison consisted of the 19th (Green Howards), the 51st (1st K.O.Y.L.I), the Ceylon battalion and one of Malays, with two companies of the H.E.I.C.'s Artillery.

The territory which lay between Kandy and the coast was unexplored, the mountain passes were difficult and dangerous, and the tracks so bad as to preclude even the use of pack animals. Swamps abounding in leeches and mosquitoes had to be traversed. Two columns operating from Colombo and Trincomalee, after fatiguing marches, but with small opposition, occupied the capital, which was found deserted. The troops on arrival all went down with fever, being shortly afterwards withdrawn except for a small detachment of Green Howards and Artillery (300) and a company of Malays.

Meanwhile what was described as a virulent form of jungle fever swept the island. Of the 400 men of the 51st who returned from Kandy to Trincomalee in April, 300 died within the next three months, including their surgeon, T. A. Reeder. In the third week in June the force left in Kandy was isolated, many of the Malays had deserted, all the Europeans were sick, and the deaths were six a day. On the 24th an attack was made on the post, when, after a defence of ten hours, the officer in command capitulated on the understanding that those who were fit should be allowed to march unmolested to the coast. Leaving 150 sick behind, the remainder, 34 British and 350 Malays and gun lascars marched out, the party including apparently the two surgeons, Holloway of the Artillery and Hope of the 19th. They were waylaid; the Malays deserted; Major Davie, the commandant and two others, were carried off captives; a corporal escaped to tell the tale; the rest were massacred. The sick in hospital had been clubbed on the head as soon as the garrison moved out. One of these was spared, being found still in the town when it was recaptured in 1815.

During the succeeding eighteen months the Governor pursued a policy of small raids into Kandyan territory which cost many lives, irritated the natives and effected nothing. As an example of what the columns had to face may be quoted part of the narrative of Capt. Johnson[1], who, through a misconception of orders, led a party of 82 Europeans and 202 Malays and sepoys right into Kandy, and thence, finding himself unsupported, fell back 200 miles on Batticaloa. "At an early stage the doolies had to be abandoned in consequence of the death or desertion of the bearers, the most helpless cases being carried in cloths fixed on bamboos. It was out of the power of the surgeon (Gillespie of the 19th) to be of much assistance to the wounded, the coolie who carried the medicines having deserted, and, as the wounds were undressed, they became in general ill-conditioned, and, at length, so offensive to the patients themselves as scarcely to be borne."

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[1] Quoted in Henry Marshall's "General Description of the Island of Ceylon."

Captain Alexander, who was of the party, wrote, "through the dreadful obstructions thrown in the way and the incessant attacks of the enemy it was found impossible to carry on the sick and wounded. These, along with the coolies, fell into the hands of the enemy. Many were taken, their hands and feet bound, their mouths stuffed with grass to prevent their cries, slung upon a bamboo pole, and thus borne off to be butchered like sheep. When the army had occasion to stop, however shortly, numbers secured in this means were rescued by their comrades, when missed in time, by a hasty charge with the bayonet." After incredible difficulties, Johnson brought in his detachment with the loss of 9 Europeans, 60 sepoys and 76 coolies. All had to go to hospital and very few came out except for burial.

The brunt of this campaign was borne by the two British regiments. The 19th died at the rate of 400 per 1,000 in 1803, 200 in 1804, and 83 in 1805. The strain must at times have been unendurable, when we read that on at least two occasions officers withdrew their men from their posts leaving the sick and wounded at the mercy of a savage enemy.

The best account of the Ceylonese Wars has been written by Henry Marshall, a distinguished officer of the Army Medical Department, and Senior Medical Officer at Colombo from 1816 to 1821.

The Mediterranean.

The year 1804 marked the centenary of the British occupation of Gibraltar and the occurrence of a most severe epidemic of yellow fever, which in the course of four months carried off a quarter of the garrison. There was much discussion as to whether the outbreak was "putrid and contagious," as held by Sir James Fellowes and Dr. Pym.[1] The Inspector of Hospitals, Dr. I. M. Nooth, and the majority of his officers, thought not. He reported: "The disease seems by no means infectious, but the whole atmosphere of the Rock is *pestiferous*." To allay anxiety he personally attended the worst cases, and did all he could to dispel the idea of infection by personal contact. At the same time steps seem to have been taken to remove the troops from the immediate neighbourhood of the town. Camps were formed on the most airy sites available, and the civil population was thinned out by removing a portion of them to tents on the neutral ground. Discharges of artillery and bonfires in the streets were employed to purify the atmosphere, "but the great heat they occasioned and the terror they inspired, turned out to be most detrimental."[2] The deaths between August and January among civilians were 4,864, and among the troops 54 officers, 864 other ranks and 164 women and children.

[1] William Pym (1772-1861), Inspector of Hospitals, 1816, wrote the first accurate description of Yellow Fever, 1815; knighted 1830. During the cholera epidemic in England of 1832 he was Chairman of the Central Board of Health.

[2] J. Hennen, "Sketches on the Medical Topography of the Mediterranean, 1830." There were further outbreaks in 1813, 1814 and 1828. In the last the garrison of 3,600 had 432 deaths.

Early in 1805 the French, who had occupied part of the Kingdom of Naples, showed a disposition to extend their conquests to Sicily, and a garrison, including some foreign regiments in British employ, was sent there. The following summer, Sir John Stuart, who was in command, landed a force of 5,400 men on the coast of Calabria, the naval forces co-operating. After an unopposed landing, a superior force of the enemy was encountered on the plains of Maida, and very thoroughly beaten, our loss being 45 killed and 282 wounded. The action occurred within ten miles of the landing place and was not followed up. Pack mules were the only form of sick transport available for the removal of the wounded to the ships. A great number of the troops were infected with malaria. The Senior Medical Officer with the force was Thomas Gunning. The following year the force in Sicily was augmented to 19,000 men, when Inspector William Franklin was sent out.

In the spring of 1807, a detachment of troops from the Mediterranean was sent to Egypt under General Frazer, and withdrawn after an inglorious campaign of a few weeks, in the course of which several of the medical officers fell into the enemy's hands. As in 1800 there was much ophthalmia. The P.M.O. was Ralph Green, Deputy-Inspector of Malta.

Buenos Ayres.

The Cape of Good Hope was recaptured by Sir David Baird in January, 1806, soon after which Sir Home Popham, the naval commodore on the station, was allowed to embark a few of the troops on a filibustering expedition to the Rio de la Plata. Buenos Ayres was captured, and later recaptured by the inhabitants, when the British garrison became prisoners of war. In deference to popular clamour, a force of 3,000 men under Sir Samuel Auchmuty was sent from England, and this was followed by 5,000 more under Lieut.-General Whitelocke. Auchmuty arrived in January, 1807, and, finding himself too weak to attempt Buenos Ayres, attacked Monte Video on the other side of the river. This he carried by assault on February 3, a fine piece of work, inscribed on the colours of the regiments engaged. Our losses were by no means small. The Assistant Surgeons followed up their corps in the attack, and two, W. Mountgarratt of the 38th and Wildair of the 87th were hit. Auchmuty's P.M.O. was Deputy-Inspector G. R. Redmond.[1] It was noted that in almost all the wounds of the lower extremity tetanus supervened, and many wounded died from this cause.

General Whitelocke reached Monte Video in May and took over command; shortly after which he was joined by Brigadier-General Craufurd with 4,000 men. Whitelocke's Inspector of Hospitals, Theodore Gordon,[2] was P.M.O. of the whole force.

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[1] Gabriel Redmond: For his career *vide* JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, Vol. xvii.

[2] Theodore Gordon: Joined as a regimental mate, 1791. Was made Principal Inspector 1810, but retired the same year on account of ill-health.

The task set the General was no easy one, but he was weak and incompetent, and made the worst of a bad job. He landed about thirty miles below Buenos Ayres on June 28. The troops, half of whom had been nine months on board ship, and were out of condition, had to carry three days' rations. The Carbineers, who were dismounted, marched in their jack-boots. No administrative instructions seem to have been issued from headquarters, but the landing orders issued by Major Frazer to his own detachment of Royal Artillery are of some interest. "The men will land with one great coat and blanket, each with a flannel waistcoat, brush, comb, razor and shaving brush, rolled in the blanket, and with such proportion of cooked provisions as may be directed. Every man to have shoe straps round his shoes to keep them on in boggy ground, the men's hair to be plaited up behind, not tied in a queue." The available transport consisted of sixty horses with pack saddles; the horses being raw cast most of their loads of reserve rations. No real effort was made to tackle the difficulties of transport and supply. The marches were not long, but there was much marshy ground to be traversed; the men were not properly fed, and arrived at their destination, exhausted, dispirited and without confidence in their leader. At Reduction, twenty miles from the starting point, touch was regained with the ships, and some of the sick and lame were evacuated; but, up to this point, as there was no sick transport, those that fell out must have been left at the mercy of the enemy.

The western suburbs of the town were occupied with little opposition on July 3. On August 5 the force of about 8,000 men was committed to the assault in thirteen separate columns. These were involved in street fighting, losing touch with each other, and having severe casualties. Finally, after 401 had been killed, 649 wounded, and 1,924 captured, the General agreed to evacuate both Buenos Ayres and Monte Video, provided prisoners were released. The expedition went home, Whitelocke was nearly lynched by the London mob, court-martialled, and cashiered.

The army engaged was made up by the concentration of three separate expeditionary forces, and the general medical staff was consequently large, consisting of an inspector of hospitals, Theodore Gordon, 2 deputy inspectors, J. R. Redmond and A. Thompson, 1 purveyor and 2 deputy purveyors, 2 physicians, 6 staff surgeons, 2 apothecaries, and 14 hospital mates. The medical casualties reported were Assistant Surgeon Fergusson (88th) killed, Buxter (87th) dangerously wounded, and four others prisoners.

Lord Cathcart's expedition in September, 1807, which, with the aid of the Navy, captured the Danish fleet and occupied Copenhagen, consisted of 18,000 men. There were no more than 200 casualties, which, with the sick, were sent into hospital at Yarmouth. The general medical staff comprised an inspector, W. R. Shrapter, 2 deputy inspectors, F. Burrows and J. Webb, 3 physicians, 4 staff surgeons, and hospital mates.

The West Indies.

The West Indian Islands still absorbed a great number of troops. The military operations there during the last seven years of the eighteenth century have been calculated as costing the army some 100,000 men, of whom half died, and the remainder were permanently incapacitated by disease. After the rupture of the Peace of Amiens in May, 1803, Saint Lucia, Tobago, and Dutch Guiana were added to the list of unhealthy stations. The deaths from sickness in the Windward and Leeward Islands during the latter half of 1803, when the garrison was about 10,000, amounted to 700. In May, 1804, after the capture of Surinam, the Commander-in-Chief reported that he had 11,000 troops dispersed over the various islands, of whom 2,000 were constantly sick. The situation demanded a considerable medical staff, and it is noticeable that most of the medical officers who rose to distinction at this time had had some early experience there. The conditions of the soldier's life contributed to the mortality. There were no recreations, food was monotonous and badly cooked, rum was cheap. In the barrack huts the hammocks were hung so closely as to touch each other.

Within their limited means the regimental officers seem to have done all in their power to improve their men's circumstances, and advice coming from a medical officer, who had gained their confidence, was usually readily accepted. The devotion of the surgeons to their work was generally recognized. But the various fevers were as yet imperfectly differentiated, the rôle played by flies and mosquitoes in disease production was unsuspected, and progress was therefore slow. Bark was noted to have a definitely favourable influence in certain localities, and was used by most practitioners indiscriminately.

The most distinguished student of tropical diseases at this period was Robert Jackson, for several years surgeon of The Buffs, whose treatise on the Fevers of Jamaica published in 1791 was translated into several languages. He was a pioneer in insisting on the value of cold water in the treatment of what were termed the contagious and endemic fevers, the first being apparently diseases of the enteric group, the second including yellow fever. As an example of the drastic methods of treatment then employed, the letter of a hospital mate to the Medical Board, dated December 6, 1801, seems worth quoting. It should be stated that it was written in malice, but it was published in an official Blue Book, and the details appear to be correct. "The men on admission were conducted to a wash-house containing the warm and cold baths. They were instantly bled to the quantity of from 16 to 20 ounces. They were, on revival from fainting, which generally occurred, plunged into a warm bath in numbers of four to six together and confined in by blankets fastened over the machine till about suffocated. From hence they were dashed into cold baths and confined until apparently lifeless. Immediately after, a strong emetic was administered, they were carried to bed, and a dose of 8 grains

of calomel and 6 of James' Powder given as a purge, which occasioned a train of distressing symptoms for the relief of which they were bled again and blistered from head to foot. They were bled a fourth and fifth time in the space of 30 hours, and usually lost from 60 to 70 ounces of blood."

Jackson's eminence as a sanitarian has been already referred to. He was a self-made man and a born fighter, having to contest every step in promotion with the Medical Board, which, at the Physician General's instigation, professed to regard him as a quack. The Board stooped to unworthy efforts in order to discredit him. During a period of half-pay he retaliated with pamphlets attacking their general policy, even driving in his arguments on the back of the Surgeon-General with his gold-headed cane, for which he did six months. He won through in the end, when the Board was reconstituted, and the Duke of York, who strongly appreciated his merits, appointed him Inspector of Hospitals in Jamaica.

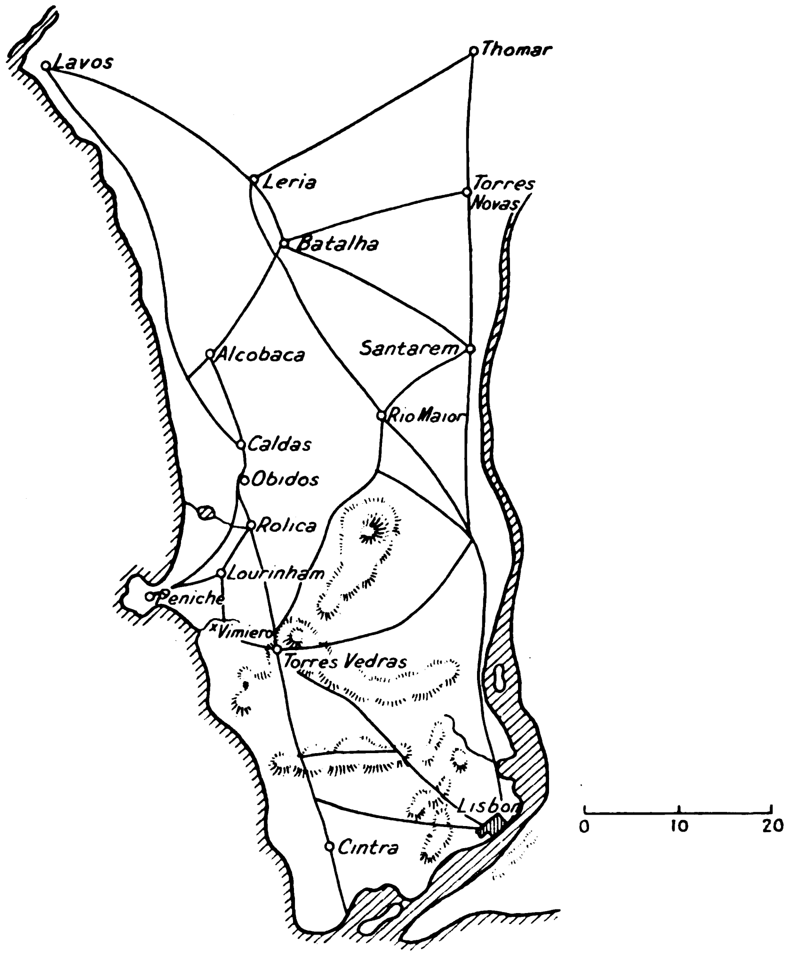
The Campaign in Portugal, 1808.

In 1808 the Spanish rose against the French, who had occupied the Peninsula, and appealed for assistance. In August, Sir Arthur Wellesley arrived at the mouth of the Mondego river, where he was joined by troops from Gibraltar, raising the number of his force to about 15,000. The immediate object was the occupation of Lisbon, which was held by the French. The men were landed with three days' bread, cooked meat, haversacks, and canteens. A spare shirt, pair of shoes, comb, razor, and brush were rolled in the great coat. The surgeon's panniers were carried on mules, the only other medical equipment being apparently twenty-four bearers (stretchers), a case of utensils, and a medicine chest, for which the Commissary was ordered to requisition two carts. The troops were dependent for supplies on the ships moving along the coast, which also provided the base hospital. The troubles of the sick in this campaign were aggravated by the scarcity of means of transport and the inefficiency of the Commissariat Officers, but also by the fact that there was no Senior Medical Staff Officer in the field to assist the A.G. staff in co-ordinating the work of the medical personnel. The Staff Surgeons referred to in General Orders seem to have been the senior regimental surgeons present with the brigades, who had also their own work to attend to.

The force advanced from Lavos on August 10, the sick and one assistant surgeon from each brigade being placed on board the transport "Enterprise" in charge of a physician, Dr. Deane. At Leria, which was reached on the 11th, casualties were left in the Portuguese hospital.

On August 17 the British encountered and drove back a detachment of the enemy at Rolica. The numbers engaged on either side did not exceed 5,000, and each had lost about 9·5 per cent of casualties. Most of ours occurred during a gallant, but premature, attack delivered by the 9th (Norfolks) and 29th (1st Worcesters). There were no medical staff officers present, most of the surgical work devolving on George Guthrie, the Surgeon of the 29th,

who was at work for three days continuously. He must thus have had the opportunity of examining wounds inflicted by our shrapnel, then used in battle for the first time. On the 21st, Wellesley took up a position at the village of Vimiero to cover the landing of fresh troops and stores from England. Here, with 1,800 men, he was attacked by Junot's main army from Lisbon, which was disposed of with a British loss of 135 killed, 534 wounded, and 51 missing.



Among those landed was Adam Neale, an army physician. Debarred by the rules of his craft from handling a scalpel, he watched the attack on Ferguson's brigade from a small farm, which became the site of the brigade dressing station. The wounded suffered much from the intense heat. After the action he entered the house. "I found I could be useful," he wrote, "to a great many, who, but for the interference in a duty which

was not strictly my own, might have remained for hours in excessive pain. To several, a simple inspection of their wounds, with a few words of consolation or perhaps a little opium, was all that could be done or recommended. Of those brave men the balls had pierced organs essentially connected with life and, in such cases, prudence equally forbids the rash interposition of unavailing art and the useless indulgence of delusive hope."[1] There were no medical comforts, but, exploring with the help of a soldier's wife, he found some meal which was made into gruel for the patients. Next morning, forty bullock carts were secured, and Neale was given the duty of transferring the wounded to the ships, which took them to Oporto. The French wounded prisoners were left with some of our surgeons in the church, with a guard for their protection.

Though the army pushed on to Torres Vedras, the victory was not followed up. Generals senior to Wellesley had arrived, and Junot's force was permitted to leave the country under the Convention of Cintra. Shortly after the battle, Sir John Moore landed with a strong force, fresh from the abortive Swedish expedition. The men, who had been four months continuously in transports, were found, on landing, to be quite incapable of marching. A general hospital was opened at Torres Vedras, being later moved to Lisbon. Moore became Commander-in-Chief in Portugal and Dr. W. R. Shrapter his Inspector of Hospitals.

Sir John Moore's Campaign.

In accordance with instructions from home to co-operate with the Spanish, Sir John Moore in October, 1808, led the British forces collected round Lisbon in a north-east direction to effect a junction with Sir David Baird who had advanced from Coruña. The nominal strength of the united armies was about 40,000, but there were numbers in hospital with dysentery acquired in the previous campaign. A hospital establishment remained at Lisbon, and depots were formed at Abrantes, Elvas, Almeida and other towns en route. When at Salamanca in the third week of November news was received that the Spanish armies were routed and the French, 100,000 strong, were advancing, Moore decided to cut off his connection with Lisbon. A bold thrust was made at Napoleon's main line of communications, which drew the whole of the French armies down on him and generally upset all their dispositions, upon which he began his famous retreat terminating in the successful action at Coruña on December 16, his own death on the field, and the embarkation of the troops. The sick who remained on the old line of communications to the number of 1,076 were safely evacuated to Lisbon, which continued to be held.

If there are any lessons to be learned by the Medical Services from the

[1] Neale, "Letters from Portugal and Spain."

retreat, they have not come down to us. Adam Neale has left a vivid account of the troubles of the sick convoy of which he was the medical officer—the desertion of the native drivers with their bullocks, the deep snow in the passes, the villages filled with Spanish soldiers in all stages of typhus. When at Mayorga it became necessary to dump the wounded prisoners of the convoy, humanity necessitated a guard up to the last possible moment to save them from massacre by the peasantry.

On the day the battle of Coruña was fought, the morning state showed 4,035 men sick, about 14 per cent of the force. These with most of the medical staff officers had already embarked before the attack commenced. Sir John Moore was struck by a cannon ball, which broke his shoulder and lacerated his side at the moment when Sir John Baird, who lost his arm, was being attended by two surgeons. Realizing that his case was hopeless, he ordered the surgeons back to their work.

The troops were embarked at Coruña and Vigo. The transports during their return were scattered by a storm. Most found their way to Portsmouth, others came to land where they could. The men disembarked haggard and unkempt, with ragged clothes and dirty accoutrements just as they had come out of action. "Things common enough in war, which struck a people only used to the daintiness of parade with surprise; and thus the miserable state of Sir John Moore's army became the topic of every letter and the theme of every country newspaper along the coast."[1]

The total loss during the whole of the operations was estimated at about 4,000, which was no more than a sixth. Of these, 800 found their way back to Portugal. All the regiments landed in a verminous state. The outbreak of typhus which followed was alarming, and spread to most of the southern garrisons. The general hospitals having been closed, the disposal of the sick fell to the Inspector of Regimental Hospitals, who had two able assistants in William Fergusson and James McGrigor, the Deputy Inspectors of the Sussex and Portsmouth Districts. The Guards' surgeons were sent down from London, and every civil practitioner round Portsmouth was employed. The Depot Hospital in the Isle of Wight was full, but most of the beds at Haslar were handed over to the Army. The regimental hospitals were opened in hired buildings, and the remaining sick overflowed into hulks, empty transports, and prison ships in the harbour. As many regiments on landing proceeded by route march to distant parts of England, no doubt much infection was spread.

[1] Napier, Peninsular War.

Current Literature.

Discussion on Undulant Fever. (Section of Medicine and Section of State Medicine, Royal Society of Medicine). Pnblished in the *Proceedings of the Royal Society of Medicine*, 1933, xxvi, 1093-1106.

This interesting discussion was opened by Sir Weldon Dalrymple-Champneys, who began with what he described as an emphatic statement, viz., "Undulant fever in this country can no longer be regarded as a medical curiosity, nor should it any longer be used only as a last desperate diagnosis when all else has been disproved. Undulant fever is a definite clinical entity which, in spite of the bewildering variety of phenomena which it may exhibit, can in most cases be diagnosed on clinical grounds alone, though confirmation should always be sought from the laboratory."

After touching on the behaviour of the disease in other parts of the world, Sir Weldon puts the question—which, he says, no one can answer—whether undulant fever started from an endemic centre in the Mediterranean and spread thence all over the world, conveyed perhaps by Maltese goats, long famous for their milk yield.

Since 1929, up to which year he could find published accounts of only fourteen cases, 115 well-authenticated cases have been reported as having occurred in England and Wales. But this does not represent the true incidence of the disease, which could only be obtained if the disease were compulsorily notifiable. The increase in the number of cases reported is remarkable, as is the increase in the number of cases reported in America, viz., from 217 in 1922 to 1,545 in 1926. This, it is suggested, is due to the growing interest in the disease and consequent more precise diagnosis.

In an analysis of his series of 115 cases the speaker excludes laboratory infections and those contracted abroad, and includes, with one exception, only cases in which there was a fever of an irregular type together with an agglutination titre for organisms of the Brucella group of at least 1 in 100. The average titre was rather more than 1 in 1,500 and in fifty-two per cent it was 1 in 1,000 or more.

A table is given showing the results of cultural tests of the blood, urine and fæces in seventy-two cases, and the diagnosis was confirmed by cultivation of the causative organism in an eighth of the cases in which culture was attempted.

A map is also published showing the distribution of the cases in England and Wales which, in spite of certain drawbacks regarding grouping and missed cases, the speaker considers does demonstrate the fact that the disease occurs in all parts of the country.

Of 111 cases, 73 were males and 38 females. As women usually drink more milk than men it would be expected that they would be the greater sufferers, but this sex distribution has been noted in other countries where

the disease has been investigated. Sir Weldon's tentative suggestion of this selection of sex is that men consume less milk and so are apt to lose their immunity to *Brucella abortus*, which immunity is maintained by women and children by the regular consumption of infected milk.

It is observed that in the table showing the age distribution of 110 patients, 61·5 per cent of the cases occurred between 30 and 60 years of age.

Of ninety-nine cases in which the occupation of the victim is given only thirteen are farm workers or persons living on farms, which is in marked contrast to what is found in other agricultural countries. Sir Weldon Dalrymple-Champneys considers that the view of Maclean, of New Zealand, that milk infection plays a small part in the epidemiology of the disease in that country, cannot be held in England. In support of his contention he publishes a table which shows that of 83 cases, for whom information is available, 78 drank raw milk, and only 6 had had contact with bovines and 3 of these had taken raw milk as well.

Infection by direct contact is then discussed and it is considered that there is good reason to suppose that this country is no exception to other countries in that cases have been reported from among workers handling infected animals or their carcasses. Sir Weldon refers to the result of the examination of the blood of ninety-eight veterinarians, carried out by Professor G. S. Wilson at the Congress of the National Veterinary Medical Association at Folkstone in 1932, sixty-three of whom had been in contact with aborting animals. The blood sera of fifteen of these contacts agglutinated Brucella, and in the non-contacts only one positive result was obtained, this subject being a laboratory worker who constantly handled cultures of Brucella.

Of channels other than direct contact, Sir Weldon considers that manure or litter of infected animals constitutes a real danger. In support he quotes Dr. Lafenêtré's twenty-five cases in France, none of whom had drunk the milk of a heavily infected herd of goats of the village; the manure of the goats had, however, been used on the patients' gardens, and the onset of the disease had occurred in each case just fifteen days after the removal of the manure to its new destination.

Professor I. Walker Hall spoke of the presence of *Br. abortus* in milk supplied to householders, and of the methods adopted in Denmark and Iowa to demonstrate the presence of agglutinins of *Br. abortus*. The experiments on the examination of milk consumed at Bristol were published in the Report of the Medical Officer of Health, Bristol, 1931, and on the lines of these experiments the following evidence has resulted :—

	No.	Positive aglutination for *Br. abortus* Per cent
Raw churn milk, January-March	100	22
,, ,, ,, April-July	100	30
,, ,, ,, August-November	100	27
Pasteurized milk	21	31
Graded milk, "A," "T.T." and "Certified"	27	44

The high incidence of pasteurized milk containing agglutinins for *Br. abortus* led to the injection of such milks into guinea-pigs, and Professor Walker Hall publishes figures for both raw milk and pasteurized milk injections. They are:—

	No. with positive agglutinations	Guinea-pig serum agglutination +	*Br. abortus* in guinea-pig tissues
Raw milk	28	22	22
Pasteurized	9	0	0

The sera of 590 healthy people were also examined and agglutinins for *Br. abortus* were found in seven per cent.

Since January, 1930, sera from all febrile patients suspected to be typhoid have been titrated for abortus agglutinins as a routine. In the last sixty-one specimens agglutinins for *Br. abortus* have been found in 4·9 per cent, and in these cases the clinical conditions have been those of undulant fever.

Professor Walker Hall suggests that such observations would be greatly enhanced if it were customary to test all influenza and other febrile disorders for the presence of Brucella antibodies.

Dr. Sinclair Miller spoke of successful results obtained by treating six cases by protein shock, using the ordinary T.A.B. vaccine. Although he did not advance this as a panacea he thought it might be tried more often than was the case now.

Later speakers included Dr. P. Manson-Bahr, who said he was the first to describe undulant fever in this country as being due to *Br. abortus* in a paper in 1927; Dr. H. Morley Fletcher (the Chairman) who remarked on the clinical features of the disease; Professor G. S. Wilson, who spoke at some length on the difficulty of interpretation of the agglutination reaction.

VATTUONE, A. B. **A New Intradermal Reaction in Ankylostomiasis.** *Med. Journ. of Australia.* 1933, 1, 645.

The author of this paper, following the suggestion of Professor Pende, Director of the Royal General Clinic of the University of Genoa, has evolved a diagnostic procedure in ankylostomiasis which he believes, from its simplicity, will be found useful and result in the saving of time of practitioners.

In the manufacture of the specific antigen patients were dieted for two days with milk only and then energetically treated with thymol. The ankylostomata, the majority of which were females, were collected. From these an antigen was prepared and put into small sterilized glass tubes which were sealed by a Bunsen burner. As controls, physiological saline solution was collected in sterilized phials and sealed in a similar manner.

Patients and carriers discovered accidentally among their relatives were then tested with both the antigen and the control saline solution. A drop of the antigen was injected into the skin in the medial aspect of the fore-

arm and at about six cubic centimetres from this puncture an injection of saline—the control—was made. In from fifteen to thirty minutes after injection the antigen gradually formed a clear, whitish blister, surrounded by a hyperæmic circle about two cubic centimetres in diameter, with an irregular dusky margin.

The control showed the blister much less distinctly, was not so white in colour, and the ring was only about 1·2 cubic centimetres in diameter and paler than the surrounding skin.

Severely affected patients gave a much more intense intradermal reaction, while carriers gave a decided, though less intense, reaction.

The maximum effect was noted from thirty to forty minutes after injection, before it slowly disappeared.

Dr. Vattuone then tried the effect of the antigen upon individuals proved to be non-infected by repeated examination of their fæces, and in every case—six in all—no reaction occurred.

Although the number of cases dealt with is not large, the author considers the results were convincing, detecting even carriers of the disease, and of greater use in diagnosing the disease itself.

The author records at length some observations on antigens in general, and concludes with what he regards as the importance of the intradermal reaction under discussion which, in a few hours, permits a medical man (assisted by a nurse) to make several hundreds of tests and to examine large numbers of persons in an infected or suspected area. Infected people and carriers may thus be immediately detected and treated without the necessity of sending fæces for examination to a distant laboratory, which procedure, in the author's opinion, is not always reliable owing to the intermittency of the ejection of eggs, which explains many negative results of microscopic examination of fæces.

To overcome the slight difficulty in the value of this reaction, i.e., a shortage of ankylostomata and, consequently of antigen, experiments have been undertaken to develop larvæ from the eggs and so infect animals. The adult worm can then be reproduced, from which the antigen is manufactured for the intradermal reaction.

Reviews.

AN EMPIRE PROBLEM. THE HOUSE AND VILLAGE IN THE TROPICS. By D. B. Blacklock, M.D. The University Press of Liverpool. London: Hodder and Stoughton, Ltd. 1932. Pp. 100. 3s. 6d. net.

Perusal of An Empire Problem (the house and village in the tropics) leaves one with mixed feelings. In the first place one is in the fullest agreement with Professor Blacklock's plea for increasing rather than decreasing the staff employed on medical and sanitary services. Everyone knows how improvement in housing, water supplies and sanitation pays in

an increase of labour output, but we would suggest that the remedies proposed are beyond all practical politics. To take a concrete instance, what would be the cost of housing the teeming millions of India with metal-roofed, iron-framed and concrete-floored houses? It is certain that the poverty-stricken ryot could not pay for them, so presumably the cost would fall on Government. In these days of a 5s. income-tax!

The chapters on Tropical Diseases are most useful for the traveller and planter for whom they are intended, but it is curious that so little stress is laid on malaria, a disease which probably causes more disability among "labour" than all the rest put together, and nothing is said about its prevention and treatment. N. L.

A SHORT HISTORY OF SURGERY. By Sir D'Arcy Power, K.B.E., F.R.C.S.Eng. London: John Bale, Sons and Danielsson, Ltd. 1933. Pp. 91. Price 3s. 6d. net.

The task of reviewing this small book has been a very pleasant one.

Every one of its ninety-one pages provides profitable reading and should fulfil the hope of the author, expressed in the preface, "to interest my readers sufficiently to make them read the older writers."

Commencing with Egyptian surgery in 2000 B.C., the book deals with surgery in the various countries of the world from the earliest known records. The influence of military surgery in France and England is well brought out, and the gradual rise of the art of surgery from the time it was only practised by itinerant practitioners to the proud position which it holds to-day is described.

The chapter on the foundation of the earliest hospitals is full of interest and describes how from being religious institutions they gradually became secularized.

The work of the great pioneers of scientific surgery in England—the Hunters, Cline, Abernethy, Astley Cooper and Hey—is described, and we are told how Lettsom and Fothergill originated the first Medical Society of London in 1773.

Full justice is done to Lister as the pioneer of modern surgery, and it is interesting to read of the distinguished men who opposed his methods.

Chapter VIII deals with the earliest development of specialism.

The reference to war surgery is very short, and the conception of the medical units designed for surgical operative work is not very clearly expressed.

The chapter on the introduction of anæsthetics is fascinating reading, and some of the interesting details of the early use of ether and chloroform are told for the first time.

As no satisfactory results can follow the most expert operation unless good after-care can be provided, the last chapter deals very appropriately with the origin and growth of nursing. There is a good index.

The book unquestionably enhances the reputation of its distinguished author as a historian. As it costs only the modest sum of 3s. 6d. we think it should be in the possession of every medical man. J. W. W.

TREATMENT OF FRACTURES IN GENERAL PRACTICE. By W. H. Ogilvie, M.D., M.Ch., F.R.C.S. London: John Bale, Sons and Danielsson, Ltd. 1932. Vol. I, pp. viii + 108; Vol. II, pp. vi + 72. Price 2s. 6d. each vol.

These two volumes, comprising 194 pages in all, appear in the series of Pocket Monographs on Practical Medicine. The first volume consists of two parts—the first being general principles of fracture treatment, and the second, the treatment of fractures of the upper limb and limb girdle.

In the first part, there is an excellent account of the pathology of bone, varieties, nomenclature, symptoms and signs of fracture, x-rays and their uses as regards fractures, repair of fractures and general principles of fracture treatment. There is a most useful and practical description of plaster of Paris work, far more than in the average textbook.

The second part of the first volume deals with the fractures of the upper extremity.

The second volume—72 pages—deals with fractures of the lower limbs and limb-girdle, and the last twelve pages with fractures of the spine and thorax. Fractures of the skull are omitted.

Whilst it is naturally impossible to cover anything like the whole ground of the treatment of fractures in such a short space, the author has managed to give a very great deal of useful information and practical detail, especially as regards general principles and the common fractures of the limbs—skeletal traction with piano wire (Kirschner's method) is described and also references are made to the methods of Lorenz Böhler of Vienna.

There is a great amount of very useful knowledge in these two small volumes. J. W. W.

FEET IN HEALTH AND DISEASE. By R. R. Hayhow, M.I.S.Ch. (London). London: John Bale, Sons and Danielsson, Ltd. 1933. Pp. 48. Price 2s. 6d. net.

As the author explains in his Preface to this small manual of forty-eight pages, his intention is to enlighten the general lay public on the importance of the feet in the maintenance of good health and the desirability of consultation with a qualified chiropodist from childhood upwards to ensure the avoidance of the numerous disabilities to which the feet are prone when neglected.

The manual fulfils its object, for it describes in clear but simple language, and in just sufficient detail to stimulate the interest of the reader, the different pathological conditions which affect the feet.

Enough treatment is given to make the reader feel he would like to consult a chiropodist for a little more definite instruction and guidance before applying the remedies.

The important subject of foot-wear, embracing boots, shoes, socks and stockings, is dealt with in more detail as it deserves, and in discussing flat-foot the author is wise to stress the importance of not using contrivances which will interfere with the normal action of the muscles. It is interesting to compare this author's views on flat-foot with this those of Dr. S. D. Fairweather as expressed in the latter's recently published book on this subject.

With a full realization of the importance of normal healthy feet to the average individual I can recommend parents to read this manual.

P. H. H.

ANATOMY (LOWER EXTREMITY). Catechism Series. By C. R. Whittaker, F.S.C.S.E., F.R.S.E. Fourth Edition. Part II. Edinburgh: E. and S. Livingstone. Pp. 68. Price 1s. 6d. net.

This latest addition to the Catechism Series of anatomy works is a very neat little volume of a size suitable for carrying in the pocket. In accordance with the usual practice, the double nomenclature is used, the old being placed in brackets.

This is not a book for the dissecting room, but it should prove extremely useful for students and others who, already conversant with the subject, wish to revise it rapidly and easily.

The subject is very well tabulated, which makes it eminently suitable for covering a considerable amount of ground in a short time. It is a book which can be used with great advantage in the odd half-hours when it might be difficult to cope with large volumes. J. P. M.

A COMPENDIUM OF THE PHARMACOPŒIAS AND FORMULARIES. By C. J. S. Thompson, M.B.E. John Bale, Sons and Danielsson, Ltd. 1933. Pp. x + 381. Price 10s. 6d. net.

A mine of information is contained in this small book, of which the seventh edition is now to hand. Its main use is that of a reference volume of handy size to the physician and practical pharmacologist. One of its very useful features to the dispenser is the synopsis of each of the chief foreign pharmacopœias contained in a form available for instant reference.

The section on modern remedies contains a full list of new preparations with their trade synonyms—a very necessary adjunct to any book which is to be of real use to the modern prescriber. The scope and diversity of the contained information are too great to be dealt with in any detail.

We feel that this volume is one of great use to the experienced practitioner as a reference book, but is likely to be too advanced for the student.

The last section is devoted to an index of diseases and their remedies. As these are given as a mere list without qualification as to method of, or indication for, use, the list does not appear to serve any useful purpose—a contention which may be exemplified from the disease "Cancer," for which some forty "remedies" are given. J. H.-S.

Correspondence.

POISONING BY TETRACHLORETHANE.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

Sir,—I have read with much interest the "Report on a Fatal Case of Poisoning by Tetrachlorethane," by Major J. M. Elliott, R.A.M.C., in the May issue of the Journal. This is the second case of fatal poisoning by ingestion of this substance which has been reported in recent years in this journal. The previous case occurred in the British Army of the Rhine in 1927, and was reported by myself in the Journal of December, 1927, under the title of "An Unusual Case of Poisoning."

It is common knowledge that tetrachlorethane is also highly toxic by inhalation. The substance was used early in the war as a solvent for the ingredients of "dope" for aeroplane fabric, and its use was later prohibited owing to the large numbers of cases of toxic jaundice which occurred from its use, with some fourteen deaths. It is not suggested that inhalation of the substance is a likely source of danger in Army offices, but in view of the fact that two fatal cases have occurred from drinking the substance, it is considered very desirable that the local order in Egypt that the "silk cleansing fluid" should be kept under lock and key and be labelled poison, should be generally adopted.

Ranikhet,
U.P. India,
June 28, 1933.

I am, etc.,
R. A. Hepple,
Major, R.A.M.C.

Notice.

A NEW TYPE OF TEAT FOR INFANTS' MILK BOTTLES.

Messrs. Cow and Gate have introduced a new type of teat for the milk bottle in the artificial feeding of babies. It is claimed that as the action required to extract milk by this teat closely resembles that used in natural breast-feeding, there is not the same tendency to palate distortion with irregular development of the teeth, nose breathing, enlarged tonsils and adenoids, as may occur through the use of teats of the usual type.

The new teat is made of rubber and is in two parts ; one part fits over the mouth of the feeding-bottle, and the second, and larger part, is placed over the first. The first part acts as a valve and a munching movement is required for the extraction of milk from the bottle.

No. 4. October, 1933. Vol. LXI.

Journal

OF THE Royal Army Medical Corps

ISSUED MONTHLY

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VOL. LXI OCTOBER, 1933. No. 4

Journal

of the

Royal Army Medical Corps.

Original Communications.

NOTES ON AIR CONDITIONING IN THE TROPICS.

BY MAJOR R. A. ANDERSON,
Royal Army Medical Corps,

AND

MAJOR J. C. SPROULE, O.B.E.,
Royal Army Medical Corps.

WITH A FOREWORD
BY MAJOR-GENERAL P. H. HENDERSON, D.S.O., K.H.P.,
Director of Hygiene.

FOREWORD.

THE subject of air conditioning is receiving widespread attention in tropical countries where plants have been installed in hospitals, offices, hotels, theatres, etc., and I have recently had an opportunity of studying two plants in London—one at the Empire Theatre and one at the London School of Hygiene and Tropical Medicine.

So far as I am aware no such plant has yet been tried in any of our military hospitals, either in the tropics or sub-tropics, and I think the time has come when a trial should be made of air conditioning in, say, two wards and an operating theatre in one of our large military hospitals in India. Such wards would enable us to depart from our present primitive and unscientific methods of treating hyperpyrexia and would provide a natural physiological method of treating not only heat-stroke cases, but any case suffering from high temperature, and would also be of inestimable value in treating post-operative cases.

16

The advantages of air conditioning in an operating theatre in the tropics appear to be self-evident.

The cost of these installations, though at present high, will doubtless be reduced as the demand increases.

Considerable information in regard to air conditioning will be found in recent Crown Agents' Bulletins.

The articles which follow have been prepared at my request.

NOTES ON AIR CONDITIONING IN THE TROPICS.

By Major R. A. ANDERSON,
Royal Army Medical Corps.

At the request of the Hygiene Directorate, War Office, the following report on air conditioning is submitted.

The problem of cooling the atmosphere in hot, dry climates with low relative humidity is, generally speaking, an easy one. All that is necessary is to pass the incoming hot, dry air through sprays of water so that by the rapid evaporation of the water the temperature of the air is reduced and its relative humidity raised to a more comfortable degree. In various parts of India this is generally carried out by the well-known system of "Khus khus tatties." These consists of furze or brushwood screens placed in open windows or doors. Water is allowed to percolate down the screen and air passes through naturally or is driven or drawn through by means of fans. This system is simple and efficacious, but it is useless for dealing with hot, moist atmospheres where the relative humidity is high.

In hot, moist climates with high relative humidity, not only the temperature of the air but also the relative humidity must be reduced. This process has come to be known as "air conditioning" and it is with this subject that these notes chiefly deal.

Air conditioning, as it is called, is accomplished as follows. If the outside air is 90° F. with relative humidity eighty per cent, and we wish to reduce it to a temperature of 75° F. with a relative humidity of sixty per cent, the air is drawn through a layer of fine water jets, the temperature of which has been reduced to 60° F. by a cooling plant, the air passing through these jets is brought to 60° F. and leaves saturated with moisture, the excess moisture representing eighty per cent relative humidity at 90° F. being removed. This air is then taken through ducts and delivered into the rooms. During its passage through the ducts the air will become heated and will actually diffuse through the room at a temperature of 75° F. It contains the same amount of moisture as it did at 60° F. and this represents at 75° F. a relative humidity of sixty per cent. The air is drawn out at floor level of the room or hall by means of outlets and is led back to the cooling machine where it can be used again in a continuous cycle. The above description illustrates the principle. In most apparatus, provision is made for the admixture of about twenty to twenty-five per cent

of fresh air during each cycle. The fresh air is drawn in through a separate duct from which mosquitoes, flies and a certain number of organisms can be eliminated by means of wire gauze and textile screens, and at the same time, disinfectants and deodorants can be added. This fresh air is also passed through the cooling apparatus after it has been mixed with the constantly circulating air.

There is thus a constant circulation of air; heated air is continually being drawn off and returned again in the form of cool, fresh air. There is no risk of chills.

The subject of air conditioning is becoming more and more popular in China, principally with regard to places of amusement in the large seaboard towns.

All along the China coast the relative humidity varies between 80 and 100 per cent during seven months of the year in the hot weather; at times the relative humidity is 98 per cent with a maximum temperature as low as 74. Even during the winter the relative humidity has been 93 per cent with a maximum temperature of 69°. This makes the climate during the hot weather almost unbearable.

Great enterprise is being shown by many firms and cinema companies in the installation of air-conditioning plants. In Shanghai air-conditioning plants have been installed in the Hong Kong and Shanghai Bank, in Malcolm's Engineering Offices, on the eighth floor of the Cathay Hotel, and in at least two cinema theatres.

During my inspection tour I took the opportunity of studying the plants in the first three places. Time was not available to carry out any experiments. My inspection tour coincided with the hot weather. As the plants are the same in principle as that installed in the King's Theatre in Hong Kong, which is described in full later, it is not proposed to comment on them here.

The apparatus installed in the Hong Kong and Shanghai Bank cost roughly about 78,000 taels (about £6,000), that in Malcolm's building 50,000 taels (about £4,500).

The sensation on entering the bank from the hot sticky atmosphere outside was one of delight and comfort. It is difficult to describe the sensation accurately; there is immediate relief and a feeling of coolness, so much so that one had the sensation of dampness although the relative humidity of the air is considerably reduced. The air gives the impression of mustiness; whether this is due to staleness is commented on later. I think the simplest way to describe the sensation is to say that it was very similar to that of entering an underground or very shaded cave. The first sensation passes off very quickly and one is left with the feeling of comfort. This may be due to the rapid accommodation of the body to different atmospheric conditions. The longer one spends in this atmosphere the more reluctant one feels to leave it. The sensation after leaving the bank is much more easily described. It is immediate: the heat

and the glare hit you at once. It must be like a sudden transference to Dante's Inferno or like putting one's head into a hot oven.

From inquiries I made from the staff I was informed that they appreciated the conditioned air very much, and as they were working in the atmosphere all day they did not have to suffer the unpleasantness experienced on leaving it.

Further inquiries elicited the fact that since the installation there has not been any increase in the sick rates of the staff, but if anything rather the reverse. There is no evidence of any increase in chest complaints. This, we must assume, is due to the uniformity of the atmosphere.

I am unable to say what the effect on the human system would be in the case of individuals who, of necessity, have to keep continually passing from this atmosphere into outside conditions. I should think it must be deleterious. Admitted the human body has wonderful powers of adapting itself to altered conditions of climate, there must come a time when the powers of adaptation would become exhausted if exposed to such excessive and repeated sudden changes.

With regard to the eighth floor of the Cathay Hotel, this floor contains the dining rooms and the ball rooms. It is only necessary to remark that from personal experience, physical exertion (in the form of dancing) in this atmosphere did not appear to have any deleterious effects. There was no undue tiredness or after-effects. It would have been interesting had it been possible to have ascertained whether energy expenditure was higher in an atmosphere of this type, as compared with ordinary conditions.

There is only one air-conditioning plant in Hong Kong. This is installed in the King's Theatre Cinema, and naturally I have had more opportunity of studying it. I propose to describe it in greater detail.

The apparatus is worked during the hot weather and closes down during the winter. I have carried out certain investigations, but unfortunately they were not completed to my own satisfaction before the closing down. I propose therefore to complete the investigations during the next hot weather, so as to enable me to come to more definite conclusions.

The chief difficulty experienced up to date with regard to the subject has been the inability to obtain any literature concerning it. Apparently one is dealing with a subject which has lacked investigation. There are many points on which I wish to refer to our expert chemist at the Royal Army Medical College (Major Elliott), whose advice and aid would be of great help. The distance between us of course means considerable delay.

In Hong Kong, opposite the King's Theatre Cinema, there is a similar large cinema, called the Queen's Theatre. The advertisements regarding these two cinemas in the past have been very amusing.

The King's Theatre:—"The only air-cooled Theatre in Hong Kong."

The Queen's Theatre:—"The Theatre where you do not have to breathe used air." "Only fresh air supplied."

The owners of the Queen's Theatre have now decided to instal an air-cooling system—work on which has begun.

The plant installed in the King's Theatre in Hong Kong is designed to supply *clean* air throughout the house so that when it is filled with people the average temperature will be about 75° F. and the relative humidity about 60 per cent.

Local weather records of Hong Kong for the past twenty years indicate that the temperature range could be expected to vary from 94° to 78° F. with a general average of 80° F. The relative humidity was found to be about 81 per cent at the average temperature of 80° F.

The aim therefore of the plant was to supply a cold dry atmosphere which would have only about one third as much moisture in it as that contained in the outside air. To *purify, dry and cool* the air, a complete plant has been installed. The essential units are the ammonia compressors, condenser, brine cooler, air washer, and circulating fan, all electrically controlled.

In practice cold brine is rapidly circulated through a series of tubes over which the incoming air is drawn by a fan. Jets of water spray on this air, washing out of it *all* dust and impurities. Its passage over the chilled coils cools it to a point where the water vapour condenses out. It is then drawn through the fan and forced into the duct system, which is installed above the ceiling of the main portion of the theatre and above the seats under the balcony.

The cool air passes downwards, being heavier, and is finally returned to the washer through the outlets or mushrooms under the seats on the floor.

After repeated changes and washings the entire atmosphere inside the theatre will be brought to about the same temperature and humidity. Sudden changes in the outside air, some of which is constantly being introduced into the system, such as increase in moisture content, or rise in temperature, will be taken into account and the compensating allowances made in the system to establish again a uniform inside atmosphere.

Some facts about the equipment may be of interest.

When nearly 1,100 people are together in a single large hall, a very definite amount of heat and products of breathing are given off. Each individual must be supplied with a certain amount of pure fresh air per minute, otherwise the hall soon becomes stuffy. In this design a total of 39,000 cubic feet of conditioned air will be supplied to the ducts overhead which will give every person in the house about 38 cubic feet of air per minute. This is a very liberal supply for a picture house—2,280 cubic feet per hour.

To purify and cool this amount of air requires the circulation of a very large amount of chilled brine. This is accomplished in a twelve-foot horizontal brine cooler. The brine circulates through the brine pipes in the air washer and back through the cooler. The cooling of the brine is

brought about by liquid ammonia evaporating inside the cooler around the brine tubes. As the ammonia evaporates, taking away the heat from the brine, the vapour is drawn into one or two ammonia compressors of the latest design, driven by directly connected synchronous motors, taking power from the incoming current at 350 volts.

The two compressors are single acting machines 8 feet by 8 feet and 9 feet by 9 feet running at 300 revolutions per minute. The smaller compressor is driven by a 75 h.p. motor and the larger by a 100 h.p. motor.

The brine circulating pump is rated at 500 G.P.M. against a 50 foot head thus giving about 25 pounds pressure through the brine cooler and coils of the washer. It is directly connected to a 16 h.p. induction motor running at 1,450 revolutions per minute. The water used in the spray system for purifying and cooling the air is circulated by a pumping unit similar to the brine pump described above; it is pure water drawn from the Colony's water system.

The circulating fan for the house is a positive acting low pressure blower, horizontally mounted and running at 875 revolutions per minute. It is driven by three "V" type rubber belts from a 20 h.p., 3 phase, 350 volts, 1,450 revs. per minute motor.

The cooling of the ammonia vapour in the ammonia condenser requires a relatively large amount of cold water. Study was first made to see if water from the local mains could be used and then re-cooled by means of a cooling pond or tower, but it was found that the amount required and the cooling area necessary entailed prohibitive costs. It was therefore decided to use sea-water for cooling the condenser. A pump house was built near Blake Pier. A directly connected centrifugal pump rated at 400 G.P.M. at a 65 foot head, driven by a 20 h.p. motor, puts sea-water through 1,100 feet of 6-inch pipes to the condenser, from whence it flows back to the sea through the nullah which runs through Pedder Street.

Some interesting points struck me. The whole of the air in the theatre passes through the apparatus in eight minutes. There is no arrangement in the apparatus for taking tobacco smoke out of the air, the mere passing the air over the coolers and through the washer does not remove the smoke. The system adopted for this purpose in the King's Theatre consists of exhaust fans placed in the roof with exits which can be opened when necessary. The smoke which accumulates in the upper strata of the atmosphere is removed by opening the exits and running the exhaust fans for two, three or four minutes. This, of course, interferes with the air conditioning and temporarily raises the temperature and relative humidity because outside air is to a certain extent drawn in from the doors.

The apparatus has to be run for two and a half to three hours before the first performance opens, so as to get the air in the theatre to the required condition. The cost of running the apparatus amounts to $130 per day (about £8). This is certainly expensive, combined with the initial outlay of a costly plant.

It is interesting to note that the apparatus to be installed in the Queen's Theatre Cinema will bring about the reduction of temperature by means of ice instead of the brine cooling plant. I understand one ton of ice will be used per day for cooling the water used for spraying and for cooling coils. It is said that this will avoid a large outlay on plant and the daily cost will be less than with the apparatus installed in the King's Theatre.

The purification of the air is relative; it certainly is not complete. Admitted that the chilling of the air will tend to inhibit growth of organisms, and that the washing removes dust and a large proportion of the organisms and some of the chemical impurities, yet it cannot remove them all.

The water which is used for washing the air is in constant circulation: in its cycle it sprays the air and takes part of the heat out; its temperature rises, it returns to be reduced in temperature again and goes back to the washing chamber.

Some of the investigations which I wish to carry out are as follows:—

(*a*) How far does the repeated chilling of this water affect the growth of organisms which it is continually removing from the air?

Are they killed? Theoretically, it would appear that droplets are removed.

(*b*) It is presumed that this water removes from the air some of the excess carbon dioxide which is continually being added to during the time the air is breathed. Does not the water reach a point where it becomes unable to take up more carbon dioxide?

(*c*) To what extent is the percentage of oxygen in this conditioned air reduced, say towards the end of the third or fourth performance? It must be borne in mind that some 20 per cent of fresh air from outside is continually being added to used air in its cycle as it passes through the apparatus.

Although we are accustomed nowadays to judge the atmosphere in a room from a point of view of maintenance of health, more from its cooling effect on the body surface rather than upon its chemical composition, there still remain certain standards.

The very limited practical investigations which I was able to carry out consisted in ascertaining the percentage of carbon dioxide in the conditioned air, and taking Kata thermometer readings inside the air-conditioned theatre, at the same time carrying out a similar investigation in the Queen's Theatre Cinema opposite. The Queen's Theatre is a very well ventilated theatre with a very large number of rotatory fans in the ceiling, and other fans ensuring very good air movement.

After many attempts to arrange matters with the managers of the theatres concerned, most of an afternoon and evening was spent in the two theatres. It was unfortunate that on the particular day chosen the temperature and relative humidity were both low.

The following table gives the averages of the Kata readings and the average percentage of carbon dioxide in the various samples taken:—

	Temp. F.	Relative humidity per cent.	Dry Kata reading	Wet Kata reading	Percentage of CO_2	Organisms falling per sq. metre per minute. No. of colonies grown
In Barracks	81	79	3·40	9·27	—	—
King's Theatre—2.30 p.m...	71	65	4·73	9·46	0·089	142
King's Theatre—9 p.m. ..	71	—	3·01	7·34	0·098	38
King's Theatre—Air: before washing	—	—	—	—	—	2.560
King's Theatre—Air: after washing	—	—	—	—	—	1,040
Queen's Theatre — Air: 2.30 p.m.	79	—	3·15	7·38	0·064	182
Queen's Theatre — Air: 9 p.m.	79	—	3·63	8·60	0·049	336

It will be noted that the temperature inside the King's Theatre is kept at about 71° F., with relative humidity of sixty-five per cent. In the Queen's Theatre the temperature remained fairly constant at 79° F. The Kata readings show very little difference between the outside air of an ordinary barrack room, the King's Theatre and the Queen's Theatre. The cooling power per square metre body surface is low when it is considered that a satisfactory standard is one which gives a dry Kata reading of about 6 and a wet Kata reading of 18.

The percentage of CO_2 is higher in the King's Theatre than in the Queen's: this, theoretically, I expected to find. Oxygen percentage was not tested; it is hoped to do this during the next hot weather. The number of colonies grown on plates exposed inside both theatres for the same length of time shows very little difference.

It is interesting to note that with regard to the number of colonies grown on plates exposed for three seconds in the air ducts, where the air is moving very rapidly, just before the air passes through the conditioning plant, and immediately after it leaves it, there are only half the number of colonies grown after it has passed through the plant.

It is realized that a very large number of analyses and considerable more work is necessary before one could become dogmatic and arrive at any sort of definite conclusions. It is hoped that other observers in the Corps will assist by giving their views and suggestions.

The following tentative conclusions have been arrived at with regard to the possible use of air conditioning in barracks:—

(1) Undoubtedly the ideal system of air conditioning would be one in which fresh air is taken from the outside, conditioned, and then passed into the building and, after use, removed into the open air by exhaust fans; in other words, where there is a constant circulation of fresh conditioned air through the building. I understand that the cost of this would be absolutely prohibitive.

(2) For the soldier, the provision of air-conditioned barracks in the tropics does not appear feasible; firstly on account of cost, secondly owing to the fact that during the day he is constantly in and out of barracks for parades, recreation, etc.

(3) The only place in the China Command where air conditioning would

be of great use is in the hospital at Shanghai. In Shanghai very severe hot weather is experienced, reaching its maximum in July and August, when a number of military cases of heatstroke and heat exhaustion, some of which prove fatal, occur.

In addition, the surgical specialist there reports that, owing to the fact that after major operations a very considerable fall of blood-pressure occurs in his patients during the hot weather, he is only able to perform urgent operations. All other routine work has to be kept over until the hot weather is finished. He further reports that the strain on the theatre staff during this period, owing to the conditions inside the theatre, is considerable, although only urgent operations are performed.

I am therefore of opinion that the operating theatre and an adjoining small ward of four or six beds, should be air conditioned. It would be useless for the operating theatre to be air conditioned alone, because most of the collapse takes place after the operation. Furthermore, there would be a decided risk of an increase in post-operative chest complaints.

The small ward would also supply an admirable place in which to treat heatstroke and heat-exhaustion cases, and, in my opinion, would afford them a much better chance of recovery.

A plant sufficient for the operating theatre and the small ward could be installed for about £500.

Although I can find no literature on experimental work with regard to air conditioning, and there appear to be many points regarding it which require elucidation, I think I am justified even at this stage in recommending it, because so far as I can ascertain no ill-effects appear to be produced, or follow, among individuals frequenting air-conditioned places.

With regard to chemical purity of an atmosphere, we must bear in mind that individuals in submarines are able to carry on when submerged in an atmosphere which cannot be considered pure, as judged by chemical standards.

I am indebted to Major W. E. Tyndall, M.C., Royal Army Medical Corps, D.A.D.P., China Command, and to Corporal G. Fawcitt, Royal Army Medical Corps, of the Command Laboratory, for their assistance and help in carrying out the analyses for me.

REPORT ON AN AIR COOLING PLANT INSTALLED IN THE HAFFKINE INSTITUTE, PAREL, BOMBAY, AND THE CARRIER COOLING PLANT INSTALLED IN THE NEW COUNCIL HALL, BOMBAY.

By Major J. C. SPROULE, O.B.E.,
Royal Army Medical Corps.

The Frigidaire Company manufacture two types of air conditioning cabinets, one being fitted with cooling and heating coils, which may be used for places which are very cold in winter and hot in summer, and the other fitted with cooling coils only. In the former the heating is carried

out by hot water or steam and in both the cooling is obtained by a compressor and refrigerant.

As the climate of Bombay seldom falls below 70° F., room coolers only are installed in the Haffkine Institute.

The room in which these coolers are installed is 23 feet 10 inches long and 18 feet 11 inches wide, with a total floor area of approximately 450 square feet. There are two large windows on the south side, and two doors, one on the east and the other on the west side of the room. One of these doors is permanently closed and the other is shut immediately after any person has used it. There are no fans or air extractors in the room.

It is stated that one standard room cooler is capable of dealing with a room of about 250 square feet floor area. The height of the room itself is immaterial since the room cooler will produce a layer of about 8 feet of cold air from the floor. The rest of the air above 8 feet from the floor will not be cooled. This is claimed to be an economy since the lower 8 feet of cooled air should be sufficient for practical purposes and the large volume of air above that height has not to be cooled.

The plant installed in the Haffkine Institute consists essentially of: (1) Two room cooler cabinets and two screens; (2) two refrigerating compressors.

Each room cooling cabinet consists of a series of cooling coils and a circulating fan, or blower. The cooling cabinets are placed in the room in which the air is to be conditioned. In front of each cabinet is placed a small screen to prevent direct draught from the cooling cabinet.

The refrigerating compressors are placed in an adjoining room, but could be placed in a basement or outside shed. These are driven by electric motors.

Principle of Operation.

Warm air from the room is drawn in at the bottom of the cabinet by the fan operating therein. The air then passes over the cooling coil, where it is cooled below its dew point and so gives up a certain quantity of its moisture. It is then forced into the room through the upper part of the cabinet at a rate stated to be 450 cubic feet per minute. Moisture so removed from the air passes through a pipe into a drain in the corner of the room.

The cold air readily mixes with the warmer air in the room and the resultant mixture has a lower temperature, and lower absolute and relative humidity than the original. There is also a slight fanning effect.

When the apparatus was first installed it was found that a drop of 10° F. in temperature, as specified originally, was too much, as the atmosphere felt positively chilly. It was also found that a pleasant effect was reached by the following figures :—

Reduction in the dry bulb 6° F.

Reduction in the wet bulb 10° to 12° F.

Eventually the machines were set so that the drop in temperature would not exceed 8° F.

The compressors have automatic switches which will stop them if an undesirably low temperature is reached. For special purposes an automatic control can be arranged for starting and stopping the plant at any desired time.

Cost of Plant.

At the present moment the cost of one cabinet cooler and one compressor, complete, would be approximately Rs. 2,600, so that under normal circumstances the total installation would come to about Rs. 3,000. This would include the cost of wiring, and other incidental charges. Duty at present on this type of machinery entering India is extraordinarily high, and may be reduced somewhat in the future.

Cost of Running.

The cost of running will depend on the cost of electric current in the particular place. To ascertain the actual cost of running, the plant was allowed to work for two hours, the meter readings being taken at the beginning and end of this time. It was found that where electricity costs one anna per unit the cost of running one compressor for one hour is three quarters of an anna. This is very low and the local agents consider that in general the electricity used will amount to somewhere about one and a half to two units per hour.

The room cooler will be able to bring the temperature down to the desired figure in about two hours, and thereafter it is kept running as long as it is necessary.

The cost of running the plant increases directly as the work increases; in other words, it would cost more to run the plant on a very hot day than it would on a day with a moderate temperature.

To test the efficiency of the plant four persons went into the room and remained in it for one hour. The dry and wet bulb readings did not change during this time. The doors were opened several times and people from outside came into the room on many occasions.

Inside readings at 11.30 a.m. and 12.30 p.m.

Dry bulb 80° F.; wet bulb 72° E. Relative humidity 65.

The outside readings taken during this time were :—

Dry bulb 82° F; wet bulb 78° F. Relative humidity 82·6.

Conclusions.

This is a type of machine which could be used in operating rooms or in wards.

As the air entering the cabinets comes from the room itself and not from outside, as in some of the larger types of air-conditioning plants, it is

considered that if used in operation rooms the air of the room would, after a time, become saturated with the anæsthetic being used.

To obviate this an extractor fan might be fitted high up in the operation room. This would entail the cooling of a larger total quantity of air. As the cabinet cooler is stated to be capable of producing a maximum drop of temperature of 12° or 15° F., and when actually seen working a drop of only 2° F. was recorded, it is considered that it would be capable of doing this.

However, trials would require to be made in places with a higher temperature than Bombay before this could be definitely ascertained.

The Director of the Haffkine Institute informed me that the greatest advantage of these cabinet coolers is felt when the temperature rises above 90° F., with a high relative humidity, and work appears to be impossible.

In conclusion, my thanks are due to Lieutenant-Colonel J. Taylor, D.S.O., M.D., D.P.H., Director of the Haffkine Institute, for his kindness in allowing me to see and experiment with this plant. Also to Mr. R. Schuepp of Messrs. Volkart Bros., Bombay, who supplied copious notes on the working of the plant and helped me with the various tests to which the plant was subjected.

THE CARRIER COOLING PLANT INSTALLED IN THE NEW COUNCIL HALL, BOMBAY.

The climate of Bombay, although equable, is warm and sticky. The coolest months of the year are December, January and February. The temperature seldom rises above 95° F. while in the so-called "cold months" of the year, the day temperature may fall to 75° F.

In 1929 the Carrier Engineering Company, of London and New York, installed a cooling and ventilating plant in the New Council Hall, Bombay.

The plant installed is known as the Carrier "downward diffusion" system, so-called because the conditioned air enters the building at a high level and, on account of its density, falls to the floor where it is removed. Invented and used originally for theatres it is stated to be eminently suitable for all buildings with high ceilings, obviating the need for air inlets around the walls.

Object of Installation.

The object of the installation is to give comfort to the occupants of the Council Hall by supplying them with air which is pure, cool and dry.

Ventilation accompanied by a reduction of temperature alone would not entirely effect this because any decrease in temperature would, through condensation, increase the relative humidity in the Hall, and it is this

factor which is the chief source of discomfort. The humidity within the Hall must also be reduced and the apparatus is capable of bringing this about.

Principles of Operation.

The manner in which this is achieved is as follows :—

Air is often drawn from outside into a chamber through two ducts, the amount of air being regulated by automatic valves. In this chamber gross impurities, such as leaves, &c., are removed.

The air now passes through baffle plates into two washing chambers or dehumidifiers. In these chambers the air passes through finely atomized sprays of water which remove all impurities, the air in its passage through this chamber having its moisture contents reduced by virtue of the lower dewpoint with which it leaves.

In a country where the air is dry no refrigerating plant is required, but in a place like Bombay with a moist climate a refrigerating plant is necessary. This is used to keep the water, used in the sprays, at the required temperature. Thus, by controlling the temperature of the water that of the air is simultaneously controlled, and this is maintained at a figure corresponding to the " dewpoint " required in the Council Hall.

The air, having been cooled and dehumidified, now passes over specially designed baffle plates which eliminate all free moisture, i.e., water in the form of droplets. It is then mixed with a small amount of air which comes from the Council Hall. The reason for this will be explained below under "prevention of draughts." The air then passes into the fan which has been drawing it along all the time and is propelled into ducts which lead to a void above the ceiling of the Council Hall. From here it is discharged through special openings arranged around the periphery of the ceiling, into the Hall. Ducts also conduct air from this void to the various galleries which surround the upper part of the hall.

Prevention of Draughts.

It has been found from experience that if air of a low temperature be admitted at a high level it will fall by virtue of its increased density, but will stratify or fail to diffuse with the air of the room into which it is descending. This will cause local or patchy cooling and set up unpleasant draughts. These are particularly noticeable with air entering at low temperatures, but disappear above certain limits.

By mixing some of the comparatively warm air from the Hall with the colder air from the dehumidifier the creation of draughts can be prevented.

The air on reaching floor level is gently extracted through hidden gratings by a suction fan. A certain portion of this extracted air is mixed with fresh air from outside and returns to the dehumidifier, thus re-commencing the cycle.

The air as it passes through the Hall absorbs heat and the volume admitted is so regulated as to maintain a comfortable temperature.

As a result of the humid exhalations of the persons present, the internal dewpoint would tend to rise and increase the humidity of the Hall, the entering air is therefore given a dewpoint which is predetermined and controlled to counteract this effect.

Control of Internal Conditions.

There are two controls, both of which are automatic: (1) Dewpoint control; (2) minimum temperature control.

(1) The dewpoint control is so arranged as to allow a constant temperature of the air leaving the dehumidifier. It consists of a thermostat, situated in the air leaving the machine, which reacts on a mixing valve, through which the refrigerated water proceeds to the dehumidifier. When the dewpoint tends to become too low, warm water, i.e., water at the Bombay temperature prevailing at the time, is permitted to mix with the cold water and conversely is shut off when the dewpoint show signs of rising.

Thus at all seasons of the year a constant dewpoint is maintained irrespective of the alterations of outside temperature and the personal idiosyncrasies of the attendants in charge of the apparatus.

(2) The minimum temperature control ensures that the temperature of the Hall does not fall below a predetermined point. It consists of a thermostat situated in the Council Hall which refers back to automatically operated dampers which close and prevent air passing through the dehumidifier when the Hall temperature falls below that for which it is set.

Both of the above controls use compressed air as the operating medium.

Refrigerating Plant.

This plant was installed by the Lightfoot Refrigerating Company. It is their ordinary type and consists of water circulating over pipes containing ammonia.

Conditions Produced by the Plant.

By the courtesy of the Public Works Department the Council Hall was visited and the plant was seen working. At the time of this visit the thermometer readings were as follows:—

OUTSIDE	Wet bulb ..	81° F.	INSIDE	Wet bulb ..	74° F.
	Dry bulb ..	90° F.		Dry bulb ..	86° F.

It will be noted that the difference between the outside and inside dry bulb readings was only 4° F.

The atmosphere of the Council Hall was particularly clear, and little or no dust particles were noticed floating about in it. The air itself felt dry and was particularly invigorating and pleasant; no draughts were noticed

in any part of the room; in fact, coming out of the steamy atmosphere of Bombay, it felt like being transported to some drier and cooler station. It is considered that the provision of an atmosphere such as this would be of the greatest benefit for hospital patients.

It was stated that the plant installed was much too powerful for the work it had to do as it could reduce the temperature to freezing point, whereas it was only required to reduce it by four or five degrees. When first installed the temperature was reduced by 12° F., but the members of the Council complained of feeling cold.

COSTS OF RUNNING THE PLANT.

While the Council is sitting the plant normally works from 9 a.m. to 4.30 p.m.

The daily expenditure is as follows :—

	Rs.	a.
Ammonia	2	0
Mobiloil B.B.	0	4
Mobiloil A.	1	2
Arctic oil C.	0	8
Energy charges	30	0
2 Coolies @ annas 14 each	1	12
Ice mechanics	4	0
Miscellaneous expenses	0	6
Total ..	40	0

Interest and depreciation are not included. Maintenance is not included as the Carrier Engineering Company claim that none is required for the first ten years.

CONCLUSIONS.

Medical officers who have spent their lives in India are of opinion that a cooling and dehumidifying system of conditioning the air would be of great advantage in the treatment of the sick.

This is fully borne out by the work already done in this direction by the medical services of the Anglo-Persian Oil Company (*vide Transactions of the Royal Society of Tropical Medicine and Hygiene*, vol. xxiii, No. 6).

Not only would the stay in hospital be curtailed in many instances, but the patients could rejoin for duty without the necessity of leave, or being sent to a hill station to recuperate.

Surgical cases would be particularly benefited both during operations and in the immediate post-operative period. Operating surgeons in India have been clamouring for some air-conditioning apparatus for operating theatres (see " Surgery in the Tropics," by F. P. Conner, pages 3, 6), and many instances can be quoted where surgeons, unlike their medical colleagues, have left India broken down in health.

It should be noted that much smaller and comparatively inexpensive installations, suitable for small rooms like operating theatres, are available.

In stations where heatstroke is prevalent, not only would the convalescence period and mortality be greatly reduced but the psychological effects on others, following such outbreaks, would be almost completely abolished.

The financial aspect of such an installation must always be an important consideration. It is suggested, however, that whereas large plants like that installed in the County Hall, Bombay, might prove to be expensive at the present juncture, it might be possible to instal smaller plants in hospitals which would supply conditioned air to the operating room and one ward at a small cost.

In conclusion, thanks are due to Mr. F. O. J. Roose, P.W.D., for valuable notes supplied to me on the working of this plant and for his kindness in having the plant operated during the period when the Council was not sitting.

REPORT ON AN INVESTIGATION OF ENERGY EXPENDED ON THE EXERCISES OF THE PHYSICAL TRAINING TABLES FOR RECRUITS OF ALL ARMS.

By Major T. F. KENNEDY, O.B.E.,
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(*Continued from p.* 192.)

The Respiratory Quotient.

The Respiratory Quotient varied very considerably in different exercises; in a large number it was considerably over unity.

The food consumed throughout the course of the experiments was of a mixed nature and did not vary much from day to day, so it is thought that the variations in the R.Q. were due to some factor or factors other than diet; this is supported by the fact that theoretically the R.Q. cannot rise higher than 1 if it is an indication of the food being consumed in the body tissues.

Tables III to VII of the Manual of Physical Training show all the exercises which give an Apparent Respiratory Quotient of over unity. The percentage of CO_2 given off, the percentage of O_2 remaining, and calories per square metre per hour are also given.

In studying the tables it will be observed that nearly all the exercises enumerated are those which affect the upper extremity, chest, abdomen and trunk, the action of whose muscles exercise an influence on the breathing. What this influence may be is difficult to say, as throughout Table III we have samples of exercises which restrict and which promote both thoracic and abdominal types of breathing.

The majority of the exercises produce a certain amount of fixation of the chest or abdominal wall with a consequent holding of the breath for a period. One is inclined to attribute the high R.Q. to this interference with normal respiration, but, on the other hand, deep breathing exercises of both the abdominal and thoracic variety gave R.Q.'s of above 1. It may be mentioned here that in all exercises where the breath was held to obtain maximum effort the sample was taken not only during, but for a short period subsequent, to the exercise.

The R.Q. is not caused by "Auspumpung" of CO_2 from the tissues, as can be seen from the summary of mean values at the end of Table III, where it will be observed that the percentage of CO_2 decreases as the R.Q. rises.

Whatever the factors affecting the R.Q. may be, it is certain that food is not alone in its influence on it. Richardson's observations that the percentage CO_2 falls as the cost of work decreases, while the percentage of O_2 and the R.Q. rise are borne out by Table VIII. The exception, viz., work value of those exercises giving R.Q.'s from 1·2 to 1·3 is accounted for by the fact that two out of six of these exercises were rope-climbing, where the energy expenditure is high.

TABLE I.

APPARENT RESPIRATORY QUOTIENTS FROM 1 TO 1·05.

	Exercise	Percentage CO_2 (atmospheric CO_2 having been deducted)	Percentage O_2	Cals. per sq. metre per hour
1.	On alternate feet hop with arms raising sideways	4·08	16·84	517·3
2.	H.f. Astride jumping	4·17	16·79	400·2
3.	F.astr. Tr.forw.bend.—Arms swinging backward, forward and upward	3·81	17·14	281·0
4.	Small jumps with single arm stretching (various directions)	3·91	17·13	417·4
5.	Jumping with alternate arms stretching (various directions	3·95	16·48	455·7
6.	Small and large arm swings	4·07	16·94	146·7
7.	H.f.K.full b.—Jumping forward, sideways and backward	4·71	16·20	421·7
8.	Arms stretching forward, sideways, upward and downward	3·80	17·21	159·6
9.	Undergrip.—Arms bend	4·02	17·10	285·5
10.	Overgrip.—Side travelling with swing	4·17	16·79	231·6
11.	Climbing	4·54	16·53	325·8
12.	Climbing. Down hand under hand without use of feet	4·17	16·79	305·2
13.	H.f. F. support Trunk bending sideways	3·98	16·92	214·8
14.	Trunk bending side to side (quickly)	2·70	17·69	219·2
15.	F.cl.H.f. Poise balance forward	4·67	16·27	117·6
16.	A.b. Poise balance forward with arms stretching (various directions)	4·68	16·27	129·2
17.	F.astr. N.r. Tr.forw.b.—Trunk bending downwards	3·68	17·40	252·2
18.	On the top bar—Left (right) knee raising, stretching and lowering	4·24	16·76	217·6
19.	On hands on ground Foot placing forward	3·83	17·10	250·6
20.	On hands on ground Feet placing forward	4·21	16·67	302·9
21.	On hands on ground Arms bending with legs parting	4·28	16·84	280·8
22.	Overgrip Legs raise waist high (beam)	4·64	16·32	189·2
23.	F.astr. H.f. Trunk bending backward	4·04	16·88	70·2
24.	Tr.forw.b. Arms swinging backward, forward and upward	4·01	17·10	263·4
25.	F.astr. A.upw.str. Tr.forw.b. — Arms swinging downward and sideways	3·90	17·80	181·6
26.	Forw. lying—Arms raising upward	4·31	16·64	181·3
27.	Position for Hurdles	8·39	17·64	153·3
28.	With fingers stretching head bending backward	3·91	17·09	68·8
29.	H.f. Feet astr. Deep breathing (abdominal)	3·68	17·78	60·7
	Mean of all Exercises	4·10	16·85	297·97

TABLE II.

APPARENT RESPIRATORY QUOTIENTS FROM 1·05 TO 1·1.

Exercise	Percentage CO_2 (atmospheric CO_2 having been deducted)	Percentage O_2	Cals. per sq. metre per hour
1. F.astr.,A.l.c.—Arms fling from low cross to sideways stretch	3·32	17·78	179·4
2. Fall hang—Arms bend	4·08	17·21	209·9
3. Overgrip Arms bend	3·92	17·31	281·9
4. Undergrip—(position)	3·75	17·48	145·0
5. Sit.pos. Trunk twisting with single arm flinging	3·34	17·87	207·0
6. F.sidew.,A.b.,Tr. to left (right) turn—Arms stretching sideways and upward	3·50	17·77	181·3
7. Lying on back—Body raising to forward reach and legs raising (alternately)	4·03	17·11	200·0
8. F.astr., A.upw.str.—Trunk bending forward	4·08	17·00	139·1
9. H.f. with knee raising double mark time	3·75	17·28	388·7
10. Lying face downward A.sidew.str.—Trunk raising (on ground)	4·07	17·04	126·4
Mean of all Exercises	3·79	17·40	210·87

TABLE III.

APPARENT RESPIRATORY QUOTIENTS FROM 1·1 TO 1·2.

Exercise	Percentage CO_2 (atmospheric CO_2 having been deducted)	Percentage O_2	Cals. per sq. metre per hour
1. Arch hanging	3·60	17·80	118·8
2. Fall hang.	3·59	17·81	131·0
3. Overgrip	3·45	17·87	141·3
4. Crossgrip	3·42	17·82	171·8
5. Cross grip. Arms bend	3·79	17·56	242·2
6. Oblique grip	3·48	17·79	161·0
7. Oblique grip. Arms bend	4·14	17·16	296·8
8. On the top bar knees raise	3·81	17·56	176·8
9. On the top bar Leg raising	3·93	17·36	218·0
10. On hands on ground Arms bend	4·59	16·76	217·7
11. Overgrip Legs full raising	4·81	16·58	227·7
12. Kneeling, sitting on heels, hands clasped behind back, Forehead on knees—Back stretching	3·98	17·45	159·0
13. F.sidew.pl. H.forw.b. Tr.forw.b. Arms flinging	3·51	17·98	194·2
14. Arms bending and stretching (slowly) (various directions)	3·47	17·82	116·1
15. Arms swinging upward	3·59	17·70	127·6
16. A.forw.r.—Arms parting	3·16	18·11	128·1
17. A.sidew.str—Arms swinging forward and upward	3·40	17·66	149·4
18. A.forw.b.—Arms flinging	2·93	18·45	145·5
19. Arms bending and stretching with fists clenched (slowly) (various directions)	3·75	17·56	104·5
20. F.astr. H.F.—Deep breathing (thoracic)	3·67	17·69	82·1
Mean of all Exercises	3·70	17·62	165·4

TABLE IV.

APPARENT RESPIRATORY QUOTIENTS FROM 1·2 TO 1·3.

Exercise	Percentage CO_2 (atmospheric CO_2 having been deducted)	Percentage O_2	Cals per sq. metre per hour
1. Climbing hand over hand (without use of feet)	3·87	17·91	423·7
2. Climbing with double rope (without use of feet)	3·89	17·89	305·3
3. On the top bar (wall bars)	3·15	18·38	126·0
4. On hands on ground	3·35	18·24	146·3
5. Sit.pos. L. straight. Feet grasp.—Trunk bending downwards	3·42	18·04	173·6
6. A. forw.r.—Arms parting (palms of hands turning upwards)	3·11	18·44	121·8
Mean of all Exercises	3·46	18·15	216·1

TABLE V.

APPARENT RESPIRATORY QUOTIENTS OVER 1·3.

Exercise	Percentage CO_2 (atmospheric CO_2 having been deducted)	Percentage O_2	Cals. per sq. metre per hour
1. Forw.lying. A.b.—Trunk bending forward and backward, Arms stretching sideways	3·46	18·29	181·5
2. Forw.lying. Hips Firm	3·14	18·90	168·5
Mean of both Exercises	3·30	18·59	170·0

TABLE VI.

SUMMARY OF MEAN VALUES.

A.R.Q.	CO_2 per cent	O_2 per cent	Cals. per sq. metre per hour
1·0 - 1·05	4·10	16·85	297·97
1·05- 1·1	3·79	17·40	210·87
1·1 - 1·2	3·70	17·62	165·4
1·2 - 1·3	3·46	18·15	216·1
Over 1·3	3·30	18·59	170·0

In conclusion, I wish to tender my sincere thanks to Major-General P. H. Henderson, the Director of Hygiene, for his permission to obtain the apparatus and to carry out the investigation, also to Lieutenant-Colonel N. Low, R.A.M.C., Professor of Hygiene at the Royal Army Medical College, for the loan of many pieces of apparatus. I wish to thank Colonel A. W. R. Sprot, D.S.O., the Commandant of the Army School of Physical Training, for giving me every facility for performing the

experiments at the School and for putting two Staff Instructors at my disposal. I am much indebted to Major D. T. Richardson, M.C., R.A.M.C., for initiating the investigation and for his valuable help and guidance throughout. Finally, I must express my thanks to Quartermaster Serjeant Instructor A. Field and Sergeant Instructor T. Wigmore, both of the Army Physical Training Staff, who spared neither time nor trouble in their assistance and without whose help it would have been impossible to carry out this work.

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QUININE PROPHYLAXIS IN NORTHERN INDIA.

By Major T. YOUNG,
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(*Continued from p.* 184.)

IV.—Indications and Technique.

Among the many methods described for administering quinine prophylactically are the following :—

Koch's.—This is known as the "long interval prophylaxis" and consists of giving fifteen grains on the tenth and eleventh days.

Plehn's.—"Double prophylaxis" consists of giving seven or eight grains of quinine every fourth and fifth, or fifth and sixth days.

Indian Method.—A medium size dose (ten grains) is given twice a week on two consecutive days.

Ziemann's.—He gave 15 grains every four days.

Deeks [40] found that prophylactic doses of 15 to 20 grains twice a week greatly reduced the number and severity of the admissions by limiting the parasitic development sufficiently to prevent severe symptoms and to establish tolerance.

Stott [41] gave ten grains thrice weekly with unsatisfactory results.

In these methods the drug is given in fairly large doses intermittently, the object being to have the quinine in the blood in sufficient concentration to kill off easily and quickly any parasites which may have entered the body meanwhile and commenced their schizogonic cycle. The argument against this "large dose" method is that in a person bitten immediately after the effect of a dose has passed off, the parasite has a considerable time to multiply before the action of the second dose is felt.

The oldest method of giving quinine is by small doses daily, and originally it was hoped that with a small quantity of quinine constantly circulating in the blood any malaria parasites introduced into the body would be immediately destroyed. We now know that this is not the case. This method, however, continues to be the favourite, and it is generally held that the small amount of quinine always present in the blood exercises its effect on the malaria parasites after they have commenced multiplying by preventing or inhibiting subsequent schizogonic cycles. In Italy a dose of two to three grains daily has accomplished good results.

In Panama good results have been reported with a daily dose of three to six grains increased or decreased according to prevalence or virulence of the disease.

Celli's method is to give three grains of quinine each morning and three

grains each evening. He holds that harmful effects from quinine are thus avoided and that quinine immunity does not occur.

Perhaps the most approved method is to give five grains daily in the evening. James recommends a further dose of five grains about midnight where a mosquito net is not being used. Castellani gives five grains daily and a double dose once a week.

Hehir [42] recommends five grains daily in stations where malaria is comparatively mild, and an extra five grains on the seventh day where the disease is moderately severe. Where severe, or very severe, ten grains is given daily for six days and twenty grains on the seventh. Watson [43] agrees that doses of less than six grains daily are of little value where malaria is intense—say where the spleen rate is over sixty. Where the malaria is intense and the population consists of immigrants he recommends ten-grain doses six days out of seven, and twenty-grain doses when suffering from pyrexia or not at work on account of ill-health. He states that 20 to 30 per cent of those taking quinine will be found to have parasites in the peripheral blood.

The Experiment in the North-West Frontier Province.

The reasons for the trial have already been discussed.

When considering the question of quinine prophylaxis originally in 1926 certain points were kept in mind :—

(1) That quinine prophylaxis was officially discountenanced, probably as the result of experiments carried out in Salonika during the war.

It was felt that conditions obtaining in Salonika might differ in essential factors from those affecting the North-West Frontier Province.

In Salonika, in addition to the trials and tribulations incidental to residence in a bad climate, the troops were exposed to the rigors and privations of a campaign. They were continuously under fire, life, apart from its dangers, was deadly monotonous and the vitality of the troops and their resistance to disease became lowered. Also it was appreciated that the type or the intensity of the infection might not be the same. In Nowshera, to which the trial was confined for the first two years, the malaria season is very short, and we can state quite definitely that, for practical purposes, infection takes place in the period between the second or third week of September and the first few days of November. (This is specially marked in an epidemic year.) There is quite a sharp line of demarcation, for while troops returning from the hills the last week in October usually contract a few cases of malaria, parties returning in November escape.

The same is true with certain modifications for other stations with which this paper deals. In Peshawar, it was found later, the season is not so well defined and is slightly earlier. In the Khyber stations the season is decidedly earlier.

In ordinary years the infection is mainly benign tertian; in epidemic years malignant tertian is the prevailing type.

Though malaria infection is intense it has been attended by very little mortality in recent years. In Nowshera the morbidity rate has varied between 255 per mille in 1925 and 491 in 1922, whereas in Peshawar the worst year recently has been 1923 with an admission ratio per thousand of 479, and the best, 1922, with a corresponding figure of 371.

Hangu and Thal, which are included in the experiment in 1929, have an even worse record.

(2) That there was a firm belief in the lay mind, particularly among planters, that quinine prophylaxis was efficacious and that this belief was shared by many eminent and experienced malariologists.

(3) That in cases where quinine prophylaxis had been employed with success, there was considerable variation in the method of administration.

(4) That prolonged administration of quinine might have disadvantages, e.g., (*a*) it might be harmful, (*b*) quinine might lose its effect (i) either by being absorbed in decreasing quantities or (ii) by the parasites becoming quinine-fast.

Controls.—In view, therefore, of the strong body of opinion in the Service and outside opposed to this method of combating malaria, it was realized that the experiment must be well controlled. In Nowshera, in 1926, the British troops selected for the trial occupied ten barrack rooms. These were old buildings with electric punkahs in the main rooms and electric overhead fans in the verandahs. All the troops used mosquito nets. From each room half of the occupants were selected for a course of quinine and the remainder were kept as controls. Both groups lived under identical conditions as to work, play, messing and accommodation. Nominal rolls of both groups were drawn out—in 1926 the quinine group numbered 210 and the control group 228. Admissions to hospital for both groups were recorded as were also attendances at quinine parades of the quinine group.

Particulars of the Trial.—The chief mosquito breeding ground was the stony, gently shelving bed of the Kabul River slowly receding from its banks after the summer floods. It was found impossible to deal effectively with the mosquito-breeding in the river, which ran parallel to barracks and at a distance of about 400 yards. During October and November larvæ of *A. stephensi*, *A. subpictus*, *A. culicifacies*, *A. maculatus*, *A. gigas* and *A. turkhudi* were all taken in this situation in large numbers.

It is interesting to note in this connection that in 1927, as late as December 3, the Kabul yielded larvæ of the *A. stephensi*, *A. turkhudi* and *A. culicifacies*—the maximum and minimum dry bulb temperatures being 79° F. and 39° F. respectively, and the temperature of the river water at the time of collection 56° F.

Another phenomenon in connection with this river, which I have not been able to explain, occurred in 1928. The river fell and the mosquito

breeding began as in previous years; and one awaited the commencement of the usual outbreak of malaria. Suddenly, for no apparent reason, mosquito breeding ceased and did not recommence. There was nothing to account for this in rainfall, humidity, temperature or wind, but the explanation may lie in some alteration in the chemical content of the water or in the failure of some necessary food supply. A welcome freedom from malaria resulted, and the year 1928 showed the lowest incidence of malaria on record.

In addition to the river, there were other sources of breeding in the immediate vicinity of barracks, e.g., wells, diggies, irrigation channels, pools after heavy rains. These, however, compared with the river, were comparatively easy to deal with.

The reservoir of infection was immense, for numerous bazaars, large and small, encroached on the barracks on all sides.

It was realized, therefore, that if the trial was to be successful, a comparatively large dose of quinine would be essential on account of the intensity of the infection to be dealt with. Watson's method, with certain modifications, was adopted.

Dose and Salt.—Ten grains of quinine sulphate. It was appreciated that quinine sulphate is not so readily absorbed as other salts, and that in treatment it sometimes fails to bring down the temperature, rendering a change of salt necessary. On the other hand, it is cheaper and it is more slowly excreted than other salts, and so its action is continued over a longer period.

The drug was made up in solution with the addition of citric acid.

Frequency of Dosage.—Daily for three weeks except Saturdays, when a purge was given with a view to stimulating the liver and increasing the power of the body to absorb quinine. It was hoped with this short course and one rest day per week that any disadvantages which might accrue from prolonged administration would not be encountered.

Time of Administration—Evening, between 6 and 7—exact time arranged so as to interfere as little as possible with games. This time also allowed for the maximum concentration of quinine in the blood during the period when the men were most likely to be bitten.

Method of Administration.—Quinine stations were established on a verandah in barracks. The parades were not held in hospital, so as to take up as little as possible of the time available for recreation. Bottles of quinine solution, a supply of one ounce gallipots and a basin of clean water water were laid out on a table, and a bucket was placed alongside on the floor. One orderly filled a gallipot with quinine solution and handed it to the first soldier, who drank it down and then called out his name (this ensured that the quinine was actually drunk). An N.C.O. recorded the attendance.

The soldier handed the gallipot to a second orderly, who washed it. One hundred men could pass through each such station in less than ten minutes.

In the case of the Royal Artillery units the orderly officer was present at quinine parades. The C.O. of the infantry attended his own parade. A medical officer was present at the earlier parades and frequently later.

Absentees were accounted for and attended later, and arrangements were made for men on guard to receive their dose.

All cases of fever were admitted to hospital, and no quinine was given in barrack (outdoor) treatment except as part of the routine post-hospital malaria course. On admission, the urine of fever cases was subjected to the acid Tanret test to determine the presence, or absence, of quinine. A routine treatment was carried out. A diaphoretic mixture was given and a sharp purge. Thereafter salicylates were administered until the diagnosis had been definitely established. Two blood-films, a thick and a thin, were taken, stained and examined on admission, and twice daily thereafter until malaria parasites were found, when quinine treatment was commenced.

In the cases of benign tertian infections this consisted of quinine sulphate ten grains t.d.s. in acid solution during the first and third weeks, an iron and arsenic tonic only being given in the second week. During the fourth to eighth weeks inclusive the case received quinine sulphate ten grains once daily. The patient was discharged from hospital as soon as he was fit enough, and he continued the course of treatment in barracks, all doses being marked up on a treatment card. Malignant tertian cases received treatment on the same lines, but for three weeks only.

As soon as a diagnosis of malaria was made, the fact was entered up on the duplicate quinine or control roll kept in hospital. The rolls were again checked as cases were discharged.

In 1926 records were maintained till the end of November, though quinine prophylaxis was only given for three weeks in October, viz., 4th to 24th inclusive.

It was thought that any malaria " suppressed " by the quinine exhibited during the three weeks in October would reveal itself before the end of November.

The results of 1926 were considered encouraging, and instructions were received to continue the trials on a larger scale, and so in 1927 the scope of the experiment was extended to include Indian troops, as well as British, in Nowshera. The quinine mixture was given for three weeks during September, and again for three weeks during October, with an interval of ten days between the courses. Owing to the commencement of training camps, manœouvres, etc., it was not considered practicable to continue observations during November. With these exceptions, the trial and the procedure carried out were exactly similar to those obtaining the previous year. The ten-day interval was adopted to eliminate or diminish any tendency for the production of quinine-fast parasites and to avoid any possible harmful effects which might result from ingestion of quinine by a large body of troops over a long and continuous period. It was recognized that the subjective effects of consumption of quinine pass

off in a few days, and it was felt that the action of quinine on the parasites might be correspondingly reduced for some reason other than the parasites becoming resistant to quinine.

In 1928, in addition to British and Indian units in Nowshera, certain British and Indian units in Peshawar were included in the experiment. The procedure was exactly the same as in the previous year, except that the dates were different, quinine being given from September 24 to October 13 and, after a ten-day interval, from October 24 to November 14. Actually, from November 1 onwards, owing to training, practice camps, etc., the issue of quinine became unreliable and records were not kept. This experiment, therefore, was considered to terminate on October 31, 1928.

In 1928 also, advantage was taken of the fact that the two-yearly relief of Chitral was taking place. On the outward journey one company of the 3/1st Punjab Regiment and one company of the 4/6th Punjab Regiment received prophylactic quinine. On the return journey the same company of the 3/1st Punjab Regiment and one company of the 3/8th Punjab Regiment received prophylactic quinine. The remainder of the force acted as a control.

The drug (bihydrochloride of quinine), two tablets of five grains each, was given in the evening during the concentration period at Dargai during the march from Dargai to Chakdara and for three days thereafter. On the return journey the tablets were given during the march from Chakdara to Dargai and for three days after the troops left Dargai. The Dargai-Chakdara zone was heavily infected with malaria. There was very little malaria in Chitral itself or in the country between Chitral and Chakdara.

Tablets of quinine were given because it was impracticable either to make up the solution or to carry it on the line of march. The bihydrochloride was used because of its greater solubility.

The diagnosis of malaria was on clinical grounds only, the detachment of a Field Ambulance accompanying the column having no facilities for microscopic examination.

(To be continued.)

THE SIGNIFICANCE OF YELLOW FEVER,

BY JOHN STILL.

THIS paper is an attempt to assess what the existence of the yellow fever virus in the world has meant to mankind in the past, and may signify in the future.

All manner of books, journals, papers and other sources have been consulted, and at the end a list of them will be found. Numbers, where they occur in brackets in the text, refer to this list, the first number giving the reference to the publication, and the second to the page. Thus (7/627) means the *British Medical Journal* of April 29, 1916, page 627. Every statement has been thus authenticated, and may be, if so desired, tracked to its source.

Yellow fever is caused by a virus, an ultramicroscopic living thing that has never yet been seen. Able to pass through the closest of filters (4/2361; 8/285; 15/526) it has been known to penetrate the skin of a man's hand and infect him with the disease (14/370). Despite this penetrative power, the disease is not ordinarily acquired by contagion (5/2362), being, like many other diseases, spread through the agency of an insect host. The host, a mosquito, bites an infective man, and twelve days later (1/3 and 6), becomes infective itself and remains so for the remainder of its life, which may last for some months (1/6). At any time during its infective period, the mosquito has only to bite a human being once for the virus to be passed back from its insect to its human host, and for the disease to spread. So the evil commerce goes on; man infects mosquito, mosquito infects man; and the virus, the invisible, impalpable cause of the infection, multiplies alternately in its human and insect carriers. But whereas man dies from the disease, the mosquito appears unaffected. Apart from its life in an animal or insect host the virus has no existence. Deprive it of mosquitoes able to infect—vectors as they are termed—or of human beings and animals susceptible of infection, and the virus lives no more.

Yellow fever is endemic at present in two wide areas of the world. In West Africa, between the desert and the sea, and far inland in the forests and grass lands of tropical Africa, the disease has existed for ages, perhaps ever since man inhabited those countries. Among British colonies, yellow fever has been reported in recent years from the Gold Coast, Sierra Leone, and Nigeria, even Nigeria's dry northern territories (10/285, 286); among French colonies, from Senegal, the French Sudan, Dahomey, the ivory Coast and Upper Volta (10/285; 16/4); from the Republic of Liberia (3/1356); from the Cameroons (10/286); from the Congos, both Belgian and French (1/203); and from the Portuguese colony Angola (1/262). In fact, it prevails along the coast from Senegal in the north to Angola in the south, and inland until the highlands of Central Africa rise to an elevation

of about 4,000 feet above sea level (1/28, 262; 24/360). Its tendency is to progress slowly eastwards and southwards.

In South America, three main foci of the disease are known; the north-west portion of the continent, where there was an epidemic in Sorocco, Colombia, in 1929 (24/359); the eastern states of Brazil, where a severe outbreak occurred in Rio in 1929; and the southern tropical regions where there has recently been an outbreak in the war zone of the Chaco (24/359). But it is held probable that the disease is endemic throughout the vast area that lies between these known foci (24/360). Biological tests show the disease to be identical in both Africa and America. There are not two kinds of yellow fever (8/285; 15/520). But the history of the disease in the two continents is widely different. In America, epidemics have been frequent and deadly, but in West Africa epidemics pass unnoticed since the natives rarely die of yellow fever (1/81). It may sometimes be with them a serious illness, but for the most part it is a minor ailment suffered in infancy (10/285). Their race has had it for so long that the West African negroes are almost immune. But the mild nature of yellow fever in West Africa is confined to negroes and persons with negro blood, natives of that land. The trivial ailment of the negro children, when borne by a mosquito to intruders from other countries, reveals itself as the same deadly disease that foiled de Lesseps in his attempt to cut the Panama Canal. The immunity is racial, not territorial, and Sierra Leone used to be known as the White Man's Grave. In like manner as the negroes' ailment proves fatal to those who invade its territory, so toò does it slay the inhabitants of the territory it invades. Some account will be given later of epidemics in America, whither yellow fever was carried by negro slaves shipped by Europeans to the New World. The first epidemic in America definitely recognizable as yellow fever occurred in Yucatan in 1649 A.D. (1/147, 180); and since then, for nearly three centuries, epidemics have been numerous, though diminishing in frequency of late years. Prior to the coming of the Europeans, neither infective man nor mosquito vector existed in the New World; both were taken from Africa in ships and later, when comparing the results in America with the possible results of importation of the virus into Asia, it will be important to bear in mind that into America both virus and vector had to be introduced before yellow fever could spread there, whereas in Asia the requisite mosquito already abounds (1/26 to 33, 266, 271; 19, 24/361).

The chief mosquito vector, or carrier, of yellow fever virus is generally called *Stegomyia fasciata* by British writers, and *Aëdes ægypti* by Americans. It has other names, both Latin and English, and in tropical Asia and elsewhere is widely known as the Tiger Mosquito, from its black and white striped body and legs. Some writers describe it as essentially a town dweller, but I have often been bitten by it in villages, and even in the depths of high forest. Until quite recently, *S. fasciata* was believed to be the only vector of yellow fever (2/27), but research has added to the list a

wide variety of mosquitoes; 8 African and 2 American species, according to one authority (1/6); 13 species, in a report published a few months later; "many kinds of common domestic mosquitoes," in a paper published in 1932 (4/2361 and 10/285). Until recently, too, it was believed that *S. fasciata* would fly but a few score yards from its birthplace, but now it has been observed to fly long distances ranging from 400 to 1,000 metres (4/2362). The distribution of *S. fasciata* is astonishingly wide, for it is found abundantly throughout the tropics everywhere. "From 38 north to 35 south latitude," says one great authority of ten years ago (1/28 to 33); "Everywhere between 40 degrees north and south latitude," says another in a paper published in December, 1932 (24/361). In Malaya, a house to house survey revealed that 98 per cent. of the houses examined held *S. fasciata* (19). In Colombo, it is one of the commonest mosquitoes.

S. fasciata prefers for its breeding places small or moderately sized collections of clear water (1/10). Its eggs and larvæ are commonly found in wells, cisterns, water barrels, tin cans, bottles, flower pots and vases, and in roof gutters (2/30; 3/1354), and this habit renders the species typically a domestic one, parasitic upon the haunts of man. But it will breed far from houses too, and larvæ have been found in mud holes, and in footprints in mud near lagoons, and even in the lagoon itself (1/11); also it breeds in knot holes in trees, and in the axils of the leaves of various plants (1/12). This power of adaptation to varied surroundings is a chief cause of its ubiquity, and has enabled it to spread wherever sailing ships with unsealed stores of water have provided a vehicle for the eggs and larvæ. The insect's life history, from egg to full development, takes from about three to eleven days (2/30, 31). Frost kills the imago, but larvæ are less tender and have been found alive in water coated with ice, and the species has been known to survive a winter in Virginia, U.S.A. (1/16, 17). Artificially dried, the eggs have retained life for eight months (1/16); all of which shows how difficult it would be to rid any extensive area of *S. fasciata*.

While the tiger mosquito was, until recently, supposed to be the sole vector of yellow fever, so too was man believed to be the only animal host of the virus, and not until May, 1927, did investigators demonstrate that the disease could be given to monkeys, with fatal effect (15/513). Since then, in the laboratory, six species of Brazilian monkeys have been infected (1/5; 15/527), and more significantly, at least four species of Asiatic monkeys, including the commonest in India and Ceylon (1/5; 10/285; 15/516). Chimpanzees, a West African monkey, provide a parallel to the natives of that region, for they have been found able to transmit infection while remaining insusceptible to the disease (1/5). Of lower animals, since 1927, several kinds have been found able to transmit the virus, including ferrets, guinea pigs, and mice; and mice are now widely used for experimenting upon (4/2366; 5/2367; 15/527,528). One creature even more distant from man which has proved infectible is the hybernating bullfrog (15/527). So,

from being an affair of man and of one species of mosquito, yellow fever has almost suddenly loomed as a disease that many animals can acquire and many mosquitoes convey. The significance of this discovery is obvious. These novel infections have been deliberately brought about in the laboratory, and might never be found in the natural state; but that remains uncertain, for negroes in Trinidad, twenty years ago, claimed to foretell the approach of an epidemic among human beings by noticing red howler monkeys dead or dying in the woods (13/1176). Of infected animals' power to pass on the virus to man there is unfortunately no room for doubt, for among 32 cases of yellow fever contracted by laboratory workers, 22 are described as arising from "contact with infectious monkey blood or tissue," 3 from "contact with infectious mouse brain," and 4 from "handling of infected animals" (14/366 to 368). The bullfrog was not found to be infective (15/527).

When the white man discovered America, he found there nations that had advanced a long way in civilization. They dwelt in organized kingdoms, and their cities excited the Spaniards' admiration. They possessed written languages, and for some hundreds of years had preserved records of notable events in their history. The ceremonies of their religions were performed in splendid temples.

Each one of their achievements has been destroyed. Their cities are forest-covered ruins. Their religion has ceased to exist. Even the written records are no longer comprehended in full by any living person; and of their kingdoms, but one remains. The whole indigenous civilization of America was utterly and finally devastated by their invaders, and among the American races, some have almost entirely perished. Wars played their part, and religious rancour, but it seems certain that even more deadly than these was the impact of new diseases, diseases for which the American Indians had no acquired immunity. Men are more deadly to one another as vehicles of pestilence than as warriors or priests. When measles, with us not a killing disease, first struck the Fijians, whose ancestors had never had it, the mortality is estimated to have been from 20 per cent to 25 per cent of the population (20/10). The New World was as fresh to Europe as if it had been another planet. Its peoples had no inherited powers of resistance to the diseases brought in the blood of the conquerors and of their slaves. Where gunpowder slew tens, the new diseases massacred thousands, and the most fatal was yellow fever. A very full and detailed account of this is given in several chapters of "Yellow Fever," by Henry Rose Carter, and from that, and other sources, the figures given below have been collected.

In the older records, all that is said is "out of so many, so many died," but whether the larger figure means the population in a given locality, or the number of the troops, or only the number of the cases, I am not able to say; so I have termed it "Population affected." Adding up all the figures, from 1649 to 1929, the mortality is 56 per cent. Most of these

epidemics were recorded in some detail because they occurred among soldiers, subject to discipline and attended by doctors. Of the mortality in epidemics among American Indian races there are no figures, but the races disappeared.

YELLOW FEVER EPIDEMICS IN AMERICA.

Date	Place	Population affected	Deaths	Percentage	Remarks	Reference
1649	Cuba	30,000	10,000	33 per cent		(1/188)
1741	Cartagena	12,000	8,431	70 ,,	Troops	(2/6)
1793	Philadelphia		4,044			(1/42)
1798	New York		2,086			(1/42)
1798	San Domingo	25,000	22,000	88 ,,	Troops	(7/627)
1802	,,	40,000	20,000	50 ,,	Troops	(7/627)
1802	Nassau	300	220	73 ,,	Troops	(2/15)
1821	Martinique	686	235	34 ,,	Troops	(2/11)
1825	,,	96	64	66 ,,	Troops	(2/11)
1840	Demarara.	Number not stated but called 69 per cent of all troops—				(2/17)
1861	St. Nazaire	42	25	60 per cent		(1/25)
1908/9	Barbados	86	36	42 ,,		(2/92)
1929	Rio	513	302	59 ,,		(19/2 and 24/359)

For comparison with these may be mentioned the great epidemic of Naples in 1764 when 10 per cent of the city's population died (1/58) ; and the malaria epidemic in Mauritius in 1867/8, when a population which had no immunity had a mortality of 27½ per cent. (1/72).

Again for comparison, two instances of yellow fever mortality in circumstances most favourable to the patients may be quoted. In American hospitals when the Panama Canal was being cut, 9·8 per cent of the cases died, although under stricter and more skilled control than has probably ever been exercised on so large a scale elsewhere (16/3) ; and, finally, thirty-two cases have occurred in laboratories among scientists engaged in yellow fever research, and of these five have died, a case mortality of 15½ per cent among sufferers who from the very onset of the disease were in the hands of brother specialists (14/369).

Interesting figures are available showing that the death-rate in Havana a few years before the first outbreak of yellow fever was such that Cuba was accounted to have a healthy climate. For the six years 1619 to 1624, the average mortality from all causes in the town was 13 per 1,000 inhabitants. In 1649, the yellow fever year, the deaths were estimated to have been one-third of the population: 333 per 1,000. Climate has small meaning apart from being a description of insect-borne diseases (1/191).

Judged by their reaction to the yellow fever virus, there are but two kinds of man : West African Negroes, and all others. To the West African a mild ailment of childhood, to the rest of mankind, a thing of terror. The usual symptoms are these : sudden attack ; severe pains in head, back, and limbs ; extreme prostration ; jaundice ; hæmorrhage ; black vomit. The dead are yellow, and deaths usually occur from the fifth to the eighth day. In survivors, convalescence is rapid and complete, and is not followed by anæmia (1/50). Those who recover are immune for life (23/423). The

disease selects the robust (1/50), and is more fatal to adults than to children (4/2361). The attack sets in from three to six days after the bite of the infected mosquito (1/4); but in a laboratory, the fever, caused by handling infectious material, has been known to begin after ten days had elapsed instead of the usual six (14/389). This point would have to be weighed when fixing a period for quarantine. The patient is only infective for the first three days of the fever (1/6), but the mosquito has been proved to remain infective for at least ninety-one days after feeding on an infected animal (1/6). Given suitable conditions, either one infected mosquito or one infective man would suffice to start an epidemic.

If yellow fever has existed from time immemorial in West Africa and since 1649 for certain in tropical America, without ever spreading elsewhere except as a temporary summer epidemic in certain cities in the temperate zone, why does it hold any special significance now? The reply is in two words: MECHANICAL TRANSPORT.

From the beginning of his story, up to yesterday, man could cross Africa in two ways only:—on foot, or conveyed by some animal, a horse or a bullock. Central Africa, from a point north of the yellow fever zone to a point south of it, consists of highlands, and in those highlands the yellow fever virus is believed to be either absent or inactive (1/24, etc). Neither on foot, nor in a cart, nor on horseback could a man cross from the infected region on the west to a susceptible region on the east of Africa within the time limit set by nature. From bite to onset of disease, six days, to the end of the infective period, three days more, nine days in all, for a journey that required months. Nor could the virus spread round the coast, for to north or to south a temperate zone intervened. Ships carried the disease to America, but around the coasts of Africa there is little traffic from the dangerous quarter. Luck has probably helped here.

If man could not cross within nine days, why should not a mosquito cross in ninety days? But how could it travel? It would not generally fly much more than half a mile, and mosquitoes do not journey far clinging to men or animals, or even in carts, if carts went so far.

Before the introduction of trains, motors, or aeroplanes, there was no way either for mosquito or for man to cross Africa within the danger period; but the safeguards which have preserved East Africa from the fate of Central America are rapidly disappearing. In August, 1931, the railway from Lobito Bay on the Atlantic to Katanga in the Belgian Congo was opened, a forty-eight hour journey. From Katanga to Bulawayo takes about the same time, and to Beira yet forty-eight hours more. So, from Portuguese territory on the west coast, where yellow fever exists, to Beira in Portuguese territory on the east coast, where the stegomyia exists without as yet the virus, is six days' journey. Nor need the disease go so far east as Beira or so far west as Lobito Bay. The vector mosquito is believed to be present along the whole length of the railway, and a passenger getting in at an intermediate station and getting out at another might

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shorten the six days considerably. Luck may have helped here too. And other railways are projected (18/16 and 16/2).

So much for railways. Motor tours from East to West Africa are already organized. You can hire a car to take you from Mombasa on the east to Lagos on the west, and back again. It is costly, but these tours are already advertised (21/70). The distance is given as 4,545 miles; too far to be crossed in nine days, but, as with the railway journey, it would not be necessary to make the whole journey in order to infect East Africa. A variety of other tours by car all about Africa are advertised, and apparently it is no longer a very difficult matter to cross Africa by motor. How far a car would carry a mosquito I do not know.

After motors, the air. There is Mrs. Mollison's glorious flight. There is also the *Campagnie Generale Transsaharienne* whose advertisements give a choice of journeys by air from West Africa to Central Africa and the Sudan (22). They are very costly, but the rich are not specifically immune to yellow fever. Motor Tours, Ltd., advertises aeroplanes to be chartered either for short hops, or for long distance flights "to Cape Town, the West Coast," etc. Aeropostale issues for advertisement a map showing red lines linking the Belgian Congo with Madagascar, though whether projected or actually operating already does not seem to be indicated. A London newspaper, on December 27, 1932, says, "Air-craft are now specially chartered in Africa for big game hunts . . . New camps for wild life study are now being established in many parts of Darkest Africa, with communication by air between them," and goes on to say that part of the £50,000 set aside by the Beit Trust for aviation development is being used for laying down new landing grounds. Africa is on the very threshold of development by air.

The question immediately arises whether aeroplanes carry mosquitoes. They can, and they do. Regular air services reach Miami, in Florida, U.S.A., from Cuba, Haiti, Dominica, Porto Rico, Panama, and many other places, and in 1931 two officers of the United States Public Health Service determined to test whether these aircraft did or did not transport live mosquitoes. Over one hundred planes were examined on their arrival, and in 20·5 per cent. of cases were found to have mosquitoes on board, including one *Stegomyia fasciata*. The investigators went further. One of them proceeded to San Juan, P. R., bred some *S. fasciata* mosquitoes, let them stain themselves chemically so that they could again be identified, and released 100 of them in three batches in separate aeroplanes. At Miami, the other man awaited their arrival. The journey from San Juan was 1,250 miles, and took ten hours including three stops at intermediate aerodromes. At each stop, the crews were changed, passengers alighted or got in, mail bags and luggage were discharged and loaded. A stiffer test it would be difficult to devise, but of the 100 stained mosquitoes 11 for certain were identified and 11 more were suspected of being the test ones. The investigators reckoned that probably 22 per cent

of the mosquitoes came through alive. At a height of 3,000 feet above the mountains of Dominica a mosquito bit the pilot of a plane (6/2780). This remarkable test leaves small doubt that mosquitoes could easily be transported alive from West Africa to East Africa by air.

The next point to consider is what would happen if yellow fever did reach East Africa, say one case. Unless the patient fell into exceptionally well-instructed care, it is highly probable that the first case, perhaps several cases, would pass unnoticed. It might be in some remote country place, and in any case, fever is so universal in the tropics that it excites neither interest nor fear. It would be put down as malaria, or as dengue, for dengue fever, a minor though painful illness, resembles the earlier stages of yellow fever closely enough to have been mistaken for it (1/65). The same mosquito carries both diseases (11/324). Also, if the victim had West African negro blood in his veins, as he might well have, he would probably have yellow fever as mildly as a white man would have dengue, though as a carrier of the disease he would be as dangerous as if he were fated to die of it, for he would infect mosquitoes.

Even if recognized, the fact that the disease had arrived in East Africa might be suppressed. In a paper published in December, 1932, by a scientist the following passage occurs : "Not long ago it was customary to pass yellow fever cases in silence to avoid quarantine measures. Even to-day I know cases from certain colonies which are well-known to every expert as permanent endemic centres, where the authorities keep the details about yellow fever so secret that even the private doctors working there cannot get any official information about their own districts." (24/362). American specialists, trying to work in Liberia, found their inquiries so hampered by official and private opposition that they gave up the campaign and came away. One yellow fever case they diagnosed in Monrovia in 1930 was promptly taken out of their hands and put in charge of an African doctor, who, when the patient died, certified the cause of death to be strangulated hernia (3/1356).

But, assuming that the first case was recognized, and reported, even then the disease might spread, for mosquito-proof houses do not everywhere exist, and the promptest measures might fail to prevent one or more mosquitoes from becoming infected. "The stegomyia mosquito attacks its victim noiselessly and persistently, both during the daytime and the night." (2/31). The three elements of doubt—recognition, admission of the fact, and successful protection, leave a lot to chance.

Knowledge of the problem grows, but no one nation can easily take effective measures without the concurrence of the other nations concerned. From Cape Guardafui on the north, to Lourenço Marques on the south, three nations govern. For about 1,100 miles runs the coast of Italian Somaliland, a colony with a population of three persons to the square mile. The next 800 miles of coast is British, Kenya and Tanganyika, with twelve persons to the square mile. Next, Portuguese East Africa, with 1,400

miles of coast, and an equally sparse population. And opposite the Portuguese colony lies Madagascar, 800 miles long, with eighteen to the square mile and under French Government. The very emptiness of these lands may minimize the danger of rapid dissemination, but their average density of population is the same as that of tropical America where it has not prevented yellow fever; and emptiness renders control almost impossible.

Motors and aircraft seem to threaten the British Colonies first, but the more immediate danger appears to be that Portuguese East Africa may be infected by the railway. Once on the coast, the plague would spread from town to town by native sailing boats.

The only argument against the probability of infection seems to be that it never has happened and so never will. But never before the present time did mechanical transport happen either. As to the developments if it did happen, there are two main differences from the conditions which obtained in America when it arrived there. There is the favourable circumstance that far more is known of the disease and its cause, and the unfavourable one that the vector already abounds in East Africa whereas it had to become established in America.

The still greater danger that the experts perceive is that the virus might spread to Asia. Throughout tropical Asia *S. fasciata* is among the commonest of domestic mosquitoes, breeding in every house and compound amid a swarming humanity. There is every condition but one, namely the virus, for a stupendous epidemic, and many years ago Sir Patrick Manson and other thoughtful men dreaded lest yellow fever should cross the Pacific and enter Asia from the east, coming in a ship to the Philippines and spreading along the islands to Malaya, Burma and India. Many years have passed and this has not happened. The Pacific is wider than the Atlantic. The sea ports of tropical America have been cleaned up and the long distance sailing ship has nearly disappeared off that track. It was sailing ships that took the mosquitoes to Yucatan and even forty, fifty, sixty-five days out of port, men have been infected on board ship, sailing ships, for the mosquitoes do not breed on board steamers (1/35). But Manson never thought of yellow fever reaching East Africa first and then entering Asia from the west. The first man to point out that danger was Sir Malcolm Watson on page 189 of his book "Rural Sanitation in the Tropics," published in 1915 when all the world was at war and heedless of other things. He has not let the warning sleep and now has increasing support from other workers in the same field. He must be accounted a prophet, but unlike some prophets he points the way to avert the peril he foresees.

If yellow fever were to become endemic in East Africa it might reach India in one of several ways. It might go direct in an aeroplane or in a ship. It might creep along the coast northwards, cross the Red Sea, and follow the coasts of Arabia in native craft. Or it might flit from island to island, to Zanzibar and Madagascar first and then to Reunion, Mauritius,

the Seychelles, the Laccadives and Maldives, and so to Ceylon and India. The Arabs are one of the great sailor races of the world and nothing has ever stopped them from sailing where they would, gun-running, smuggling, slave-trading, or on their lawful occasions. Who would know if yellow fever appeared in the Maldives, that lonely group of islets ruled by a Sultan where not one European resides and scarce one ever calls, where mosquitoes and fevers abound, and whence sailing ships trade freely with India and Ceylon?

If the disease were thus, or otherwise, to reach southern Asia, the conditions encountered there would differ widely from those in the present areas of endemicity. The government of Asia is so rapidly passing into the hands of Asiatics that within a generation all public health and medical services will be manned entirely by Asiatics. The personnel of inland transport services, of the police, and of the governments themselves will be the same, and so few will be the European officials that comparatively few casualties will cripple them. Asia differs from the whole of the rest of the world in the nature of its religious beliefs and social customs, and among caste Hindus, even amcng Mahomedans, house to house inspection and domestic mosquito control might easily prove impossible. In tropical Asia, too, the density of the population favours rapid spread of any epidemic as these figures show.

Region	Area in sq. miles	Population	Persons to sq. mile
Central America, Colombia, Brazil and Venezuela	4,341,000	56,600,000	13
West Africa, Senegal to Angola	4,588,000	60,000,000	13
India, British, Dutch and French colonies in Southern Asia, and Siam	3,081,000	443,000,000	143

In the African Group, Nigeria has the densest population with fifty-six persons to the square mile, and Siam, with fifty-nine, has the least dense of the Asiatic Group.

Notable warnings have been uttered by men with expert knowledge. Speaking at the centenary meeting of the British Medical Association in July, 1932, Sir Malcolm Watson said: "As things are at present, introduction of yellow fever into East Africa is certain. The measures so far proposed to prevent it are futile. So appalling would be the results of the spread of the disease that precautions against that spread must be correspondingly stringent. There should be an immediate and complete embargo on all air traffic from West to East Africa. An investigation should be at once undertaken into the degree of immunity, if any, of the East African populations, and there should be established in London a permanent yellow fever committee, consisting of medical men and administrators, and business men, to deal with the matter of the imminent spread of yellow fever to susceptible populations in East Africa and India." (10/324).

In an article in the *Straits Budget* of January 21, 1932, the same expert

said, "Even if an outbreak in Asia led to a mortality of only twenty-five per cent at the beginning, the disorganization of trade and supply, and the impossibility of caring for the sick, would rush the mortality up to any figure among the half starved and bewildered people." (20/10).

In December, 1932, Professor W. H. Hoffman of Havana wrote: "The situation to-day is much worse than ten years ago," (24/359), and again, "Is it necessary to wait for the next ten years to bring us the great pandemic as the natural consequence, with the unavoidable endemic infection of the rest of the tropical world? I feel that everything has not been done, or is being done, to prevent what may be a catastrophe for the whole human race" (24/362).

So the prophets know their own minds. But it is not unlikely that they may be unable to persuade the politicians who rule the world to take strong enough action before the time has passed when action can avert the danger. Or, getting action promised, it may be whittled down and delayed to meet vested interests or to satisfy prejudice, or jealousy. Experts generally disagree on some points, but if the yellow fever experts disagree, surely, in view of the stake at issue, it would be best to adopt the most stringent of their several proposals rather than the least. The difficulties in the way of escaping from the stage of conferences and getting actually to work are immense. In his book "Health Progress and Administration in the West Indies," published in 1916, Sir Rubert Boyce, F.R.S., wrote, "Yellow fever is a dying disease." It was thought so then, and may be still, but not by the experts.

Then there will be the opposition of the flying and motoring interests, and it is hard indeed to set back what looks like progress. Enforcement of quarantine would annul the whole advantage of speed by air, and even quarantine could hardly provide in a thinly populated country against the risks attendant upon private flying, or against forced landings. Then there is the stupidity and timidity of small officialdom, coupled with lethargy due to hot climates, and the reluctance which such persons feel to admit the existence of a disease that involves troublesome measures of control, and interference with local liberty and trade. "Yellow fever! Bury him quick, and say nothing," would sometimes be the policy. And the mosquitoes that bit him before he died would wait, and after twelve days would become infective themselves and would begin the epidemic.

Then there is the curious and perplexing difficulty that yellow fever is not regarded by West African Negroes as a major pest, but ranks after smallpox, sleeping sickness, relapsing fever, and several other diseases (10/288). Native administrations will be difficult to convince that drastic measures are necessary in order that distant and unknown Asia may be saved from peril.

And finally, greater than all, there is the political difficulty of getting any conference of the members of several nations to agree to do anything at all except to find formulæ which conceal deep disagreement and bitter

jealousy. In West Africa the nations concerned are six: England, France. Belgium, Spain, Portugal, and Liberia. In East Africa there are four: England, France and Portugal again, and also Italy, and perhaps one must count Zanzibar. But when Asia is reached, the Powers to be roused to action must run into scores, if not hundreds.

The jealousies of small men may defeat the wisdom of the great, and lack of imagination cause infinite, and fatal, delay; but there are certain rays of hope. Not the ray offered by those who say that what has not happened in the past will not happen in the future. Perhaps some were of that opinion in Yucatan before 1649.

The great hope of the bacteriologists lies in finding a vaccine that will completely immunize men against the disease. They are on the track of some such preparation, and have had some success in experiments made upon monkeys and mice (15/521). A human being who has recovered from yellow fever is immune for life, and a serum prepared from his blood protects monkeys. Sera prepared from people who had had yellow fever even so long before as from thirty to seventy-eight years were found to give protection in 75 per cent of the tests (23/423). Mice, too, provide preparations which give some immunity to monkeys (15/527); no less than 48,000 doses being available from the brain of one mouse (11/824). Work is also being done on dengue, a disease in some way allied to yellow fever, with the idea of, perhaps, finding some protection in that direction (11/325).

The great hope of those who would absolutely prevent the virus from being carried from West to East Africa lies in the British Government. From the temperate zone in the north to the temperate zone in the south of Africa, Great Britain administers an unbroken belt of colonies. None can pass from the yellow fever haunted regions of West Africa to the susceptible areas of East Africa without crossing British territory. To gain time for the vaccine to be discovered, or perfected, is the best hope there is of preventing the spread of the disease, and of all the nations concerned, immediately or at long range, England alone can act without prior agreement having been come to with other Powers.

It is a tremendous responsibility, for if yellow fever were to reach Asia through reluctance to use this power, what answer could England give to the millions of Asiatics she has governed for so long? One fourth or one fifth of the human race lives in tropical Asia.

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THE DUTIES OF AN OFFICER OF THE R.A.M.C. TO SOLDIERS OF HIS OWN CORPS.[1]

By "T.O."

The subject of my lecture to-night is one which perhaps at times is partially overshadowed, as far as officers of the Corps are concerned, by the subject of "duties of an officer of the Royal Army Medical Corps to the men under his professional care." For this reason a little reminder or refresher talk on the "duties of an officer of the Royal Army Medical Corps to the men of his own Corps" has suggested itself to our Deputy Director of Medical Services and I will endeavour to place before you briefly what I consider to be the most essential of these duties. I hope that I interpret the intention of this lecture as being that I should more particularly emphasize the way in which an officer of the Royal Army Medical Corps can assist the soldier working under him to obtain advancement in his trade, or in the ranks of the Corps. It is expected that, in my capacity as Training Officer, I should be fully conversant with these subjects.

In everyday work one frequently comes across cases where a N.C.O. or soldier has so suffered through lack of advice from an officer as to the best course he should adopt, that he misses the earliest chances of advancement in a trade or promotion, which may affect his whole career, particularly when the higher ranks are reached. I hope to deal with a few such examples at the end of this talk.

I would like to say that I realize that much that I shall talk about will appear to be obvious and elementary, and if I appear to be somewhat dictatorial in my methods I ask you to bear kindly with me for the benefit of those more junior who may be listening.

(1) *The difficulties of the R.A.M.C. officer as regards obtaining knowledge of the men of his Corps in comparison with officers of other branches of the Service.*

One must acknowledge that the organization of the R.A.M.C., with its meagre peace establishment of officers, at Home anyhow, does not readily permit the contact between officer and man which is such a satisfactory feature in an infantry battalion. In this unit each company, and also each platoon, has its own commanding officer, who is, one might say, permanently with the unit, and whose duties are whole time regimental as regards the opportunities of getting to know and interest themselves in their men.

In the Corps, as you are so well aware, the position is very different. The R.A.M.C. officer has to be a Jack of all trades and yet Master of all—

[1] Lecture given at the Cambridge Hospital, Aldershot, in the R.A.M.C. Winter Training Programme, 1932-1933.

indeed "In arduis fidelis." With the exception of the officers at the Depot and a few company officers outside, the officers of the R.A.M.C. are for the greater part carrying out technical duties, i.e., those of their own profession, and with few exceptions their period of tenure of any one job is always in the lap of the gods, "the exigencies of the Service." Consequently their chances of getting to know their men and their individual characteristics are somewhat limited.

You will be rather inclined, perhaps, to urge that the few points I hope to make this evening should apply to company officers or assistant training officers. My reply to that must be primarily "Yes," but I will also endeavour to show how officers other than those can, and should, quite easily play their part in carrying out their duties towards the men directly serving under them.

(2) *The reason for the necessity for a display of interest in the welfare of the soldier of one's own Corps.*

Firstly.—It is a fact of everyday life that if one wishes to get the best out of one's horse or car one must treat it with care and interest oneself in its daily condition. May I be permitted to apply the analogy to men under one's charge. If a soldier who is working for you realizes that the officer of the Corps to which he belongs is trying to help him along, and is ready to give advice at all times, he becomes, unless a a rotter, a willing worker for you and likely to do you credit. On the other hand, if he realizes the opposite is taking place he is inclined to adopt the attitude of "What's the good of anything? Why, nothing!" and will be of little use to the individual officer under whom he is serving. Further, most of us in this room must realize the extent to which at one time or another in our service we have been indebted to a "soldier" of our own Corps for helping us out of a difficulty or in advancing our careers in the Army. Gratitude for such help can be well repaid by all officers maintaining the greatest interest in their men, from the last joined private to the most senior warrant officer and by inculcating this spirit of interest among the junior officers of the Corps.

Secondly.—Quite apart from this first and perhaps somewhat selfish motive the officer has an additional duty towards his own Corps, namely, to produce men who will be happy whilst serving therein, and who will foster the Corps spirit and carry on the traditions of the past. Such a spirit is only maintained by officers taking a personal interest in their men and doing all for their welfare, and being careful to avoid criticism of Corps methods or administration, especially in the presence of other ranks.

(3) *How is this interest to be shown?*

Before one commences to be interested in any individual, whether *male or female,* it is customary to observe and treasure in one's memory the personal characteristics of that individual. I do not intend that this portion of my lecture should devolve into one of "How to choose a wife,"

however helpful my long experience might be to some of my listeners, but rather confine myself to the male aspect only. Therefore, first of all get to know your man. How? When he first reports to the company office, or to your ward or special department; don't think that you have done your duty by having him paraded before you and then dismissed to his duties.

Remember—just as one's first impressions of a soldier so often tell when sizing him up, so correspondingly the soldier's first impressions will be assisting him in sizing you up, and perhaps your attitude towards him may well be the cause of creating that first barrier between you and him, namely, his maintenance of a close reserve of mind, and consequently you will obtain little information out of him as to his characteristics, etc.

No! Do not do the heavy type of company officer or heavy father, or grandmother for that matter. Just show that you want to know all about him and wish to help him. As you know only too well the average soldier-men, like officers, when herded together, become like schoolchildren—tongue-tied in the presence of higher authority—*but* that when the higher authority talks to an individual in the absence of others the individual loses that assumed shyness and talks freely. That is the point I wish to make—talk to your man alone if you can and be free with him without being familiar, and you learn a lot from him and he will respect you.

What are you going to find out about him?

Well, sum up his general appearance, find out what educational or trade qualifications he possesses, if any, give advice thereon, i.e., if not in possession of a Second Class Certificate of Education show him how handicapped he will be in the Corps—no promotion, even to Lance-Corporal—choice of trades is limited to three, mental nursing orderly, hospital cook, and nursing orderly, and that the Second Class Certificate of Education is essential for advancement to Class I of these groups. Do not expect that every recruit joining from the Depot will have a Second Class Certificate of Education. The Depot staff do their level best to ensure that any man of reasonable intelligence obtains that certificate before joining a company, but circumstances often arise which may prevent this ideal from being attained in all cases. Special attention should be paid to any such men joining and every endeavour made to give them a reasonable opportunity of obtaining the certificate.

Find out if he already has a trade, tell him what to do for advancement, and see that he goes into a class if necessary. Information about all this is given in Standing Orders, R.A.M.C.

Here I would particularly stress that the company officer should carefully note whether the following documents have been rendered and completed on transfer from a soldier's last station or company:—

Progress Report on Training.
Pages 6 and 7 of A.B. 64, Part I.
Employment Sheet, A.F. B.2066H.

Summary of Training as a Nurse (in the case of men undergoing training as nurses).

The effects of failure to see that these documents are there and maintained may have a serious effect on the question of advancement of a soldier in his trade and be the cause of a legitimate grievance. I will give an example later on.

Find out his athletic qualifications, whether footballer, boxer, swimmer, cricketer or billiards player; his social attainments, whether vocalist or instrumentalist, etc. If married, all about his family. Does he belong to the Corps Association ; tell him the advantages of belonging to this and enrol him early.

(4) *Steps taken to maintain the interest.* These may be summed up in a few headings :—

(i) *Organization of games* in the company; football, cricket, tennis, boxing, swimming, and encouraging beginners' interest by coaching and playing with them ; if physique, anno domini, or other reasons prevent this, then at least turn up and see them play. Nothing encourages men more than knowing that the officer has taken the trouble to give up a probably far more interesting afternoon of sport to do so. These remarks should not be confined to officers commanding units and company officers.

(ii) *Sending knowledgeable representatives* to station athletic games committees.

(iii) *Organization of "socials,"* dances, concerts.

(iv) *Good messing arrangements.* Old adage—"The way to a man's heart is through his stomach."

(v) *Personal hygiene.* Good clothing and sufficient barrack accommodation and amenities, on a par at least with other branches of the Service.

(vi) *Married*—interest in family—information *re* welfare centres and schools.

(vii) *General discipline and turn-out* of men. Of course this in Aldershot and the neighbourhood is necessarily of a very high order, but elsewhere it is not always so. As you know a bad turn-out brings discredit not only on the individual soldier but on his officer and the Corps.

Under the heading of "discipline" may I bring in the subject of "familiarity"? We know the old adage "familiarity breeds contempt." One would rather like to impress this adage on an officer—let us say a specialist officer—whose line of work entails his having to rely on a highly trained orderly for the carrying out for him of many of the practical applications of his craft, i.e., a high-class trade. (I do hope that any specialist officers present won't say that I am calling them tradesmen.) Which one of you has not suffered, when doing company officer, from the effects of the familiar terms on which a certain specialist officer was with his assistant? What was the result? The assistant had a first-rate brain and manner and was excellent at his job and realized it so much that one morning on waking up he found that a six and seven-eighths inches Service cap would

no longer fit—he felt that he was on such good terms with his specialist officer that he could do no wrong, and if he did, he argued that he would not be punished, for had he not his specialist officer, and perhaps second in command into the bargain, behind him? The matron, sister, serjeant-major, all in turn were flouted, but of course in the long run disaster overcame him. One felt that the fault lay with the specialist officer in the first place. It is appreciated that working in close relation with a person tends to produce familiarity—it is human nature after all, but it has to be fought, especially in the Services where discipline has to be maintained in spite of the close terms upon which one may be working with one's men.

(viii) (*a*) *Educational*—watching the soldier's progress, arranging for attendance at educational classes. I mean real interest, not just leaving the detail to others without inquiring into the man's educational state yourself. Try to arrange duty hours so that men can attend schools sometimes outside the company, as I have seen done by keen officers especially at out stations. Ensure that men selected for training become educationally qualified in order to be eligible to join a class for a trade if further selected.

(*b*) *Trade.*—See that the prescribed courses are held and that the soldier gets the opportunity of attending them, and take your share of instruction where possible. In this matter specialist officers and officers in charge of wards can appreciably assist men working under them. Do not leave the question of the further advancement of your assistant in a trade to the company officer, but look up in Standing Orders R.A.M.C. what he has to do further. I often see a man due for advancement from Class II. to Class I. of a highly specialized trade, with a year's service as such, expecting to sit at the next half-yearly examination, and without having undergone the prescribed "refresher" course under his specialist officer. When this is discovered it may be too late for him to do so, and he cannot sit for six months. Look up paragraph 501A Standing Orders R.A.M.C. regarding the procedure for applying for courses. Discuss the case with your company officer and see that your man has a fair chance, and your assistant will work all the better. To officers in charge of wards, busy though you are, may I stress the importance of cultivating the excellent habit when examining your cases of always giving instruction to the orderlies whilst doing so. By this I do not mean a long dissertation on the cases, but just pointing out important points a few at a time and asking them a few questions daily. Such a procedure will be appreciated by your orderlies and they will repay you for the trouble taken. Do not forget to send in Corps Form 22 every month and to see that men's names are on this as under training, for if a name is missed out a query will be raised by the man that he has been under training for such a time, and our records, as taken from Corps Form 22, will not show this, and he may suffer financially, &c.

(*c*) *Promotion.*—Company officers so often overlook these classes. They should ascertain if there are any privates or N.C.O.s who are desirous of qualifying for promotion or further promotion, and should study the

procedure referred to in paragraphs 457 and 466 Standing Orders R.A.M.C. They should arrange for the instruction and examination to be completed before the end of the quarter, as soldiers are only noted as having qualified from the first day of the quarter following the date upon which their certificates are sent via the Training Officer to Officer i/c R.A.M.C. Records. This sounds rather involved, but I will give an example of how it works from among the examples to which I will now pass on.

(5) *Examples.*—I propose to give a few practical examples illustrating some of the types of cases that I have already mentioned, showing how a soldier may suffer by losing his turn for promotion or chances of qualifying in a trade, or full advancement in such trade, through lack of interest in his welfare, or may be through ignorance of the Standing Orders affecting him on the part of the officer concerned.

(i) Ex-Recruit "A" joins a company from the Depot, say on January 16, 1932, and has been selected by the Training Officer for the trade of sanitary assistant. This is communicated by the Officer i/c R.A.M.C. Records to the Company Officer when posting orders are issued on Corps Form 3. The Company Officer notes this and says to himself: "Right, this man will be taken for the Sanitary Assistant Class at the Army School of Hygiene in April"—and does no more. The recruit eventually attends the course and fails at the examination held at the end of it. This man, therefore, has no trade rate of pay to look forward to.

Ex-Recruit "B" (his pal) is posted to another company on the same date as recruit "A" and is noted for sanitary assistant training. This Company Officer is wise: he puts the man in a Nursing Orderly, Class III, class pending his going to the Army School of Hygiene. Such a man can sit at the May examination whilst undergoing the course, and we will assume he passes his Nursing Orderly, Class III, examination. Later on he sits for his Sanitary Assistant, Class III, examination and, like Recruit "A," fails, but he can be mustered as a Nursing Orderly, Class III, from the day of passing the examination for that trade, provided he has a year's service.

The two ex-recruits compare notes and Recruit "A" realizes he was not given a chance—Company Officer to blame.

Further, Recruit "A" also might not have been selected for the next Sanitary Assistant, Class III, class, owing to the supply available being greater than the demand. As he had not been placed under training for Nursing Orderly, Class III, and was not taken for Sanitary Assistant, Class III, class in April, he could not sit for Nursing Orderly, Class III, until the November examination.

I would ask you to note that such an example can well apply to men selected for other trades such as radiographer, laboratory assistant, masseur, etc., who, though selected for training as such, may not be taken for the next available class.

(ii) A Private, Class III Nursing Orderly, arrives at a station overseas

and states to his Company Officer that he is due for advancement to Nursing Orderly, Class II. The officer commanding the company finds that the various documents that I stressed early on in this lecture are not to be traced, or if he has them he finds them incomplete and no record of training shown. The soldier persists that he has completed the requisite period of training, including six months in wards under sisters. The matter has to be referred home and an endeavour made to obtain his records of training from his last station or stations. Quite apart from this delay, it may not in the end be practicable to verify his statement, and the soldier suffers financially and otherwise. This should not have occurred if paragraphs 98A and B and 496 Standing Orders R.A.M.C. had been complied with in the first place. I cannot emphasize sufficiently this type of case, only too common, the occurrence of which was avoidable if somebody had done his duty.

(iii) Hospital Cook, Class II: An excellent cook and likely to make a good N.C.O. has completed three years' service and has undergone all the necessary training for advancement to Class I, but it is suddenly discovered that he has no Second Class Certificate of Education which is prescribed as necessary for such advancement. This should have been noticed before by his Company Officer and he should have been given his chance earlier in his career (he may have, possibly, of course). Such a man cannot be selected for training as a N.C.O. because he has not a Second Class Certificate. You will see from this how he is handicapped and starts late in the race for promotion.

(iv) *Radiographer, masseur, laboratory assistant, special treatment orderly, sanitary assistant and mental nursing orderly.*

A Lance-Corporal, Class II, employed in one of these trades under a Specialist Officer has all qualifications for promotion to Corporal except Class I of his trade. He has completed his full period of employment as Class II assistant in his trade just before a half-yearly examination at which he wishes to sit for qualification as Class I. It is discovered that he has not undergone the prescribed "refresher" course of three months or so. This N.C.O. will not be allowed to sit until he has completed such a course and will lose an important six months seniority on the promotion roll, an event that may seriously handicap him.

(v) A Staff-Serjeant stationed at home fully qualified for promotion to Quarter-Master Serjeant except that he has not passed Part "A" of the Senior Course for Promotion. He is allowed by his Company Officer to train for Part "A" at Company Headquarters and sits at the half-yearly examination. The papers are sent to the Training Officer, but it is discovered that the N.C.O. has not been to the depot for the course in Part "A." The examination has to be cancelled and the N.C.O. has to wait at least another six months before he can qualify and so may lose his turn for promotion.

(vi) A senior Private is placed under training for the Junior Course of

Instruction for Promotion, and also a senior Corporal for the Intermediate Course about April 1. We will say that they are qualified by July 1. Their names will not be forwarded to the Officer i/c R.A.M.C. Records until August 1 and will be recorded by the Officer i/c R.A.M.C. Records as having qualified from that date. If such soldiers had been put under training from February 1, they would be qualified by May 1, and thus perhaps would save themselves from being passed over on the Seniority Roll. This example shows why it is necessary for Company Officers to arrange their promotion classes from the first day of the quarters, February, May, August and November.

(vii) I would point out that men should not be switched over from training from one trade to another unless there is sufficient time for them to complete the necessary period of training before the next examination, if by doing so they are delayed in getting trade pay.

A case that was recently referred to my office was that of a Nursing Orderly, Class III, who had failed in the May examinations. About August his company asked if he might be placed under training for Clerk with a view to his sitting in November for this examination. It was pointed out that such a man could not complete his training in that time. As therefore the soldier could not draw any trade pay until next May if he persisted in training as a clerk, he was quite rightly put back to nursing and ought to pass in November for Class III.

(viii) Candidates for Class I trades should be permitted to sit for their examination for advancement as soon as possible after they have completed the period of training prescribed and not have to wait until they have completed a year's employment in Class II. They would not, however, be graded until their year's service had been completed. This is often not appreciated by officers and an opportunity for taking the examination may slip by, and when the men wish to sit at the next half-yearly examination something crops up to prevent them and they are thrown back six months, which may even affect their turn for promotion.

(ix) Another point, men should not be prevented from sitting for an examination just because they are due for transfer to the Army Reserve before they can be graded. The qualification gained by examination will be of subsequent use to them if recalled to the Colours.

(6) *Examination.*—Lastly, may I say a few words on Corps Examinations and the duties of an officer who is a President or Member of an Examining Board, as these indeed are some of the most important duties of an officer of the Corps. The careful and even marking of both written and practical examinations is so essential that I cannot stress the necessity for this too much. One realizes what a trouble these examinations are to officers, but it is a most important duty and not one to be done in a slipshod manner, for the results of your decisions are reflected in the N.C.Os. and tradesmen of the future. May I sum up my points on this question in a few don'ts :—

(*a*) Don't let a man sit for an examination unless there is a really reasonable prospect of his passing—waste of your time and mine.

(*b*) Don't pass a man at the examination irrespective of the work done just because he is a good fellow and you don't like to fail him—one does meet obvious cases.

(*c*) Don't pass any candidate for dispenser who is doubtful in his work; we cannot afford to take risks in this trade, on which so much depends, and remember the Pharmaceutical Society of Great Britain has always got its eye on our work and we must maintain the high standard.

(*d*) Don't, especially in the Class I examinations, mark a man up in the orals and practicals whose marks for the papers are very low. A man whose marks for the papers in many subjects are found to be consistently low and yet is marked to eighty and even ninety in orals makes the Training Officer suspicious of the consistency of the Board of Examiners.

(*e*) Don't write remarks, ribald or otherwise, all over the answer papers, however much your feelings may urge you to do so.

(f) Don't forget to read carefully the pamphlet of "Instructions to Local Examining Boards" which is issued at each examination, especially as to the method of completing Corps Form 21.

(7) In conclusion, I have endeavoured to put before you some features, as I see them, of the duties of an officer of the Royal Army Medical Corps towards his men. I am afraid what I have told you must have appeared as very elementary and I apologize to the body of my listeners, but the examples I have quoted and errors I have stressed are based, not on theory, but on observations made in the course of my daily work, and which I think you will agree could and should with advantage have been avoided by a little more display of interest by somebody and, I contend, by the officer concerned.

May I suggest a partial remedy, in the form of a slogan? "Read more Standing Orders, so frequently amended but easily digested."

I am indebted to Major-General J. A. Hartigan, C.B., C.M.G., D.S.O., K.H.P., Deputy Director of Medical Services, Aldershot Command, for the interest he has shown in the subject of this paper, for his courtesy in suggesting an idea or two towards its completion, and for his kind permission to forward it for publication.

Editorial.

YELLOW FEVER.

ONE of the great difficulties in controlling yellow fever has been the inability to diagnose by clinical methods the disease occurring among the native inhabitants of a suspected area. Beeuwkes, Bauer and Mahaffy were unable to diagnose clinically the mild cases believed to be constantly occurring among the native population in West Africa, but by means of protection tests they proved the existence of yellow fever in several large towns.

Thirty per cent of the sera collected at random from persons living in Ibadan and Ilorin protected, and in Ife, where an epidemic had recently occurred, sixty-eight per cent of the sera gave protection. Similar tests in French Niger and Dahomey gave forty-four per cent positive results among adults. In South America protection tests have given similar results.

Hindle considers that the results of these protection tests show that a large percentage of the inhabitants of endemic areas acquire an immunity without an apparent attack of the disease, and that only a small percentage of the cases of yellow fever are recognized as such. He believes that the endemic areas of West Africa and South America remain a potential danger to the health of countries containing the transmitting mosquitoes and the necessary climatic factors.

The protection tests are based on the discovery by Stokes, Bauer and Hudson that yellow fever can be transmitted to monkeys (*Macacus rhesus* and *Macacus sinicus*) and maintained in these animals by the direct inoculation of blood or other tissues or by the bites of mosquitoes.

The blood from yellow fever patients in the first three days of illness was found to be capable of infecting *Macacus rhesus* and retained its infectivity *in vitro* for several days, so that samples could be sent to a central laboratory and thus enable a diagnosis to be made in very mild cases not recognizable clinically. Later, Beeuwkes, Bauer and Mahaffy discovered that the blood-serum of persons who have suffered from yellow fever, however long ago or in however mild a form, will protect *Macacus rhesus* from the effects of inoculation with yellow fever virus. This procedure was called "the protection test in monkeys."

The dose of serum (5 cubic centimetres) is injected intraperitoneally into the monkey, and four hours later the dose of virus (1 cubic centimetre of 1 in 10 dilution of blood from an infected monkey at the onset of illness) is injected subcutaneously. Two animals are used for each experiment, and only when both animals are protected is the serum declared to be that of a person who has suffered from yellow fever.

In July, 1930, Dr. Theiler, of the Harvard Medical School, found that white mice could be infected with yellow fever if the inoculation was made intracerebrally. The disease produced is encephalitis, but if the cerebral tissue is injected into monkeys typical yellow fever is produced in them. After repeated passage of the virus through mice the virus becomes "fixed" and kills all mice on the fifth day after intracerebral inoculation. Death is prevented when serum from a recovered yellow fever patient is injected into the brain along with the virus. This is called "the intracerebral protection test in mice."

Sawyer and Lloyd made the test more sensitive by injecting the virus into the peritoneal cavity and at the same time a mild irritant into the brain to localize the virus there. In employing the test for ascertaining whether persons have had yellow fever in the past mice are used in groups of six and observed for fourteen days; if the serum is from a true case of yellow fever, all the mice should survive, while all the controls without serum should die. This modified method is called "the intraperitoneal protection test in mice."

The reliability of the test has been inquired into by many observers, particularly by Hughes and Sawyer, who "are convinced that with reasonable care the test is remarkably specific and reliable, and a positive result is strong evidence that the donor of the serum has previously been infected with the virus of yellow fever."

Dr. Russell, Director of the International Health Division, Rockefeller Foundation, considers "a definite positive result very strong evidence in favour of previous infection with the virus; when groups of persons are studied, rare non-specific reactions become of less importance, and the tests give information of great value in epidemiological studies."

In 1929 the Rockefeller Yellow Fever Commission in West Africa began to use the "monkey protection test" to secure information concerning the past distribution of yellow fever in that country. The monkey test has now been largely replaced by the "intraperitoneal test in mice."

The reliability of the protection tests is no longer in doubt, but it is not easy to interpret results from regions where the decision has to be made whether the disease is constantly present in endemic form or occurs only as intermittent epidemics. Dr. Russell informed the Yellow Fever Commission that "a recent epidemic in a highly susceptible community, or two or three epidemics at short intervals, might give the same percentage of immunes as would be caused if the infection were constantly present in a community large enough to permit the disease to persist continuously."

In Nigeria protection test surveys on a large scale have recently given positive results in localities widely separated from one another and with widely differing climatic conditions. The Report prepared by the Yellow Fever Commission of the *Office International d'Hygiène Publique* states that it would be incorrect to class all these localities as endemic foci or to consider that there is, necessarily, a risk of contracting yellow fever in

them. What is now required is to supplement the indication of past infection afforded by the results of the protection test survey by intensive local inquiry into the several factors on which permanent endemicity depends. Dr. Russell wrote to the Commission that it may be the case that the "veritable endemic foci of yellow fever are fewer and more circumscribed than is sometimes supposed, but that the centres liable to the occurrence of epidemics of brief duration are more numerous and cover a wider geographical range." It is desirable that the difference should be emphasized in order to correct the alarm caused by loose statements indicating without qualification that yellow fever is exceedingly widely distributed in West Africa.

If the results of positive protection tests are followed up by local investigation and appropriate action is taken, there is no doubt that the geographical distribution of yellow fever will be reduced. If there is accurate knowledge of where and when the disease occurs, it can soon be stamped out if action is taken in accordance with the basic observations that yellow fever is transmitted only from human cases in the first three days of the attack; that the incubation of fresh cases does not exceed six days; that the agent of transmission is a domestic mosquito which remains in the vicinity of the house where it has fed, and that the insect must survive for twelve days after feeding before it can transmit the virus to another person.

As a result of field experiments under artificial conditions the yellow fever mosquito has been credited with a wide range of dispersal, but practical investigations have shown that yellow fever seldom occurs more than a few yards from an infected house. Carter, after a wide experience of the disease, wrote that seventy-five yards would be about as far as one would expect the infection to be conveyed.

According to Hindle the incubation period before a mosquito becomes infective depends on the temperature. Ability to infect may be acquired in four days at 37° C., whilst at 21° C. eighteen days are needed. At 10° to 15° C. the virus persists in mosquitoes without their bite becoming infective, but if subsequently kept at 20° C. they become infective. Hereditary transmission to the offspring of infected mosquitoes has been definitely excluded.

Besides transmission by means of the bites of infected mosquitoes, it has been shown beyond question that it is possible to acquire yellow fever by handling infected material. There has been a large number of laboratory infections in which there was no definite evidence except the handling of blood or other tissues of infected monkeys. Possible risks of spread from laboratories concerned with the diagnosis of yellow fever have caused some countries where yellow fever has never existed, but where the mosquito vector is abundant, to object to this procedure. The Governments of India, the Dutch East Indies and the Belgian Congo have made regulations under which it is forbidden to introduce, or to work with,

material containing, or suspected to contain, the virus of yellow fever in any form.

It has been claimed that Europeans who have resided for a long time in an epidemic area of yellow fever acquire "residential immunity" (*immunité de séjour*). Beeuwkes and others have shown that the immunity, if it exists, is not due to the presence of antibodies in the blood, for the sera of twenty-five persons who had resided for some seventeen years in Nigeria did not possess any protecting power. Work is now being carried out at the Yellow Fever Laboratory of the Rockefeller Foundation, New York, with a view to the production of a prophylactic vaccine which will confer a lasting immunity on inoculated persons. The procedure was devised by Sawyer, Kitchen, and Wray Lloyd. The vaccine consists of two parts: (1) A ten per cent suspension of mouse-brain tissue containing the virus is prepared in fresh sterile human serum, next tested for sterility and centrifuged. The supernatant fluid is then passed through Seitz or Berkefeld N filters. (2) Immune serum is obtained from persons recently recovered from yellow fever, pooled and dried. For use the dried serum is dissolved in water and brought to the original volume: about 0·03 cubic centimetre is injected per kilogram of body weight. In practice the immune serum is injected subcutaneously in two different places in the abdominal wall and immediately afterwards the dissolved vaccine is injected in a similar manner.

The vaccine is now being used experimentally for the protection of laboratory and field workers exposed to yellow fever infection. The next step will probably be the vaccination of European members of the Colonial Civil and Military Services whose duties take them to countries where there is risk of contracting the disease.

The duration of the immunity of this method of vaccination is not known, and there may be difficulties in obtaining the human serum in large quantities; but if effective vaccination could be applied even on a small scale it would assist the natural cessation of epidemic spread by "failure of the human host."

Fears of the spread of yellow fever by aerial traffic would probably be allayed if all aircraft crews and passengers from infected areas to uninfected areas were required to be vaccinated.

In the *International Sanitary Convention for Aerial Navigation* very strict rules for the prevention of the spread of yellow fever are prescribed. Some sanitarians consider that these rules are a concession to the alarmist point of view and exceed the needs of the case. This may be true, but the Permanent Committee of the Yellow Fever Commission decided that sanitary safeguards must overrule all other considerations.

Signatory countries have agreed to take steps for searching out unrecognizable cases of the disease by biological methods, and if it is found to be present for defining its geographical distribution. They have decided that measures for preventing the spread of yellow fever by aerial

traffic shall be taken primarily before departure from the area where the disease exists and only secondarily at ports of arrival.

Countries which are not infected but are infectible may refuse to permit the entry of aircraft from infected countries provided they report the reason for the prohibition.

Experimental work has been undertaken by the U.S.A. Public Health Service to determine whether or not live mosquitoes can be transported accidentally in aircraft and if so the possible numbers carried. The Belgians have also conducted researches on the Belgian Congo air route which is in regular operation between Boma, Leopoldsville, Coquilhatville, and Elisabethville. From these experiments there is no doubt that by air-transport mosquitoes can be carried long distances, but at tropical airports fortuitous infestation of aircraft is not likely to be heavy. The carriage of a few infected mosquitoes into a new zone where local conditions are propitious might be an event of epidemiological importance. The American workers, however, consider that the importation of infected man is of more importance than the introduction of a few infected mosquitoes.

In order to maintain sanitary control over aircraft it is essential that those working on international lines should depart and arrive at certain authorized aerodromes where the requisite sanitary provisions as regards personnel will be maintained.

According to the *International Sanitary Convention for Aerial Navigation* an authorized aerodrome means a customs or other aerodrome on which aircraft may make their first landing on entering a territory, or which they may make their place of departure on leaving a territory. Each Contracting Party to the Convention, taking into account the risks to which his territory may be exposed, may establish sanitary aerodromes. A sanitary aerodrome should at all times have at its disposal (*a*) an organized medical service with one medical officer and one or more sanitary inspectors; (*b*) a place for medical inspection ; (*c*) equipment for taking and despatching suspected material for examination in a laboratory, if such examination cannot be made on the spot ; (*d*) means to isolate, transport, and care for the sick and to isolate contacts; (*e*) apparatus necessary to undertake disinsectization, etc.

Every aerodrome which is situated in a region in which yellow fever exists in a form clinically or biologically recognizable must in addition to the above requirements be ; (1) situated at an adequate distance from the nearest inhabited centre; (2) provided with a water supply which shall be completely protected against mosquitoes and kept as free as possible from mosquitoes by the suppression of breeding grounds; (3) provided with a mosquito-proofed dwelling for the crews of aircraft and the staff of the aerodrome; (4) provided with a mosquito-proofed dwelling in which passengers can be accommodated or retained in hospital when necessary. Every aerodrome established and equipped in accordance with these provisions is called an "anti-amaryl" aerodrome. If such an aerodrome does

not exist in a region where yellow fever has been discovered or exists in an endemic form, aerial navigation from this region to another territory must be suspended until an anti-amaryl aerodrome has been constructed.

Where the anti-amaryl aerodrome is not infected but yellow fever exists in the area, the aircraft and cargo must be inspected to ensure that they are free from mosquitoes. The passengers and crew must be medically inspected and those suspected to be suffering from yellow fever or who have been exposed to infection with yellow fever will be required to remain under observation at the aerodrome or other suitable place until six days have elapsed since their exposure to infection. The names of the crew and passengers with relevant information as to exposure and duration of observation will be entered in the journey log book.

If an anti-amaryl aerodrome becomes infected all aerial navigation from it must be suspended until measures have been taken to free it from infection. Aircraft flying between two regions where yellow fever exists must depart from or land at an anti-amaryl aerodrome.

If an aircraft lands at a sanitary aerodrome in an area where yellow fever is not known but where conditions suitable for its development exist, the aircraft and cargo will be inspected for the presence of mosquitoes and the passengers and crew medically examined. If conditions are not suitable for the development of yellow fever, aircraft coming from any area where yellow fever exists may land on any sanitary or authorized aerodrome and similar inspection will be made.

According to the Convention if aircraft arrive from an infected area within the incubation period of yellow fever they will be subjected to surveillance and the duty of observing the passengers and crews until the expiration of the maximum incubation period will devolve on the sanity authorities of places to which they are proceeding. In the case of a forced landing the commander of the aircraft must report to the nearest sanitary authority and passengers must not leave the locality until permission has been given by the Medical Officer of Health of the area. The maximum incubation period is considered to have commenced on the date of embarkation in the infected zone. If a case of yellow fever occurs during the air journey, the patient will have to be removed to an isolation hospital, and the crew and other passengers put under observation until the expiration of the incubation period.

Clinical and other Notes.

UNDULANT FEVER.

By Major R. N. PHEASE,
Royal Army Medical Corps.

The following notes on an outbreak of undulant fever which occurred in January, 1932, among the 2nd Battalion, The Lancashire Fusiliers, stationed at Ferozepore, are of interest, firstly because of the rarity with which this fever is nowadays seen among British troops serving in India, and secondly because of the possibility that mild cases may be missed and the pyrexia ascribed to an enteric group infection.

Epidemiology.—Five cases were encountered, all being in the same company. On inquiry, it was ascertained that this company was on detachment duty at Amritsar from October to December, 1931, where presumably infection had occurred.

There being no military dairy at Amritsar, the milk for use in the company dining hall and cookhouse was obtained from a local contractor. The procedure was for the contractor to drive his cows up to the cookhouse, where they were milked into vessels supplied by the cook and previously scalded with boiling water. By this method "dry milking," and the diluting of the milk with water previously introduced into the receptacle to increase the bulk, were circumvented. The milk was boiled in the cookhouse prior to issue.

On being questioned, each patient volunteered the information that while the above procedure was carried out with all milk actually bought by the company for messing purposes, after the company had purchased its requirements, the remainder of the milk was retailed to individuals who bought one or two annas worth to drink with their breakfast porridge. This milk was not boiled. Such a procedure was, of course, highly irregular and contrary to order.

Symptoms.—The symptoms, for the most part, were those of continuous fever with sudden onset and varying duration, the shortest being 20 days, the longest 114 days. Four of the five cases developed articular pains in various joints; one case had an epididymitis, though whether this was a complication or a concurrent disease is doubtful, as he had been hit in the scrotum by a football prior to admission; profuse sweating was marked in only one case. Slight pulmonary complications manifested themselves in two cases. Total leucocyte counts always showed a leucopænia. All cases eventually recovered, though convalescence was protracted, except in the mildest cases.

Diagnosis.—At the onset the cases were regarded as enteric group

infection, the continued pyrexia, leucopænia, and absence of physical signs being suggestive of a mild infection.

In consequence of a previous outbreak of undulant fever among Indian troops in Lahore district having escaped recognition for a considerable time, it has since been the custom in the district laboratory, when carrying out Widal reactions on patients with N.Y.D. pyrexia, to omit the control test and substitute an agglutination test with emulsions of melitensis, paramelitensis and abortus, using the patient's serum in a single (final) dilution of 1 in 250. As all the T.A. and B. emulsions were standardized, and were known not to be auto-agglutinable, the omission of the control was in no way detrimental to the test. Incubation was carried out for two hours at 56° C., and the results were read along with the ordinary Widal. If any of the three tubes showed agglutination in the above dilution, the test was repeated with emulsions of the Brucella group throughout the complete range of dilutions. By this means it was hoped to detect a Brucella infection without substantially increasing the work involved in carrying out the routine Widal examinations; the high dilution of serum used decreased the likelihood of non-specific agglutination. How far this method was successful will be commented on later.

Bacteriology.—The results of the Widal reactions carried out against the enteric and Brucella groups of organisms are shown in Table I.

The earliest serological indication of Brucella group infection was obtained in Case 2 on the nineteenth day of pyrexia. This is considerably later in the disease than is usually experienced, and is due, it is considered, to the high dilution of the serum used, coupled with the relatively short incubation period. Had the racks, after the preliminary reading after two hours at 56° C., been placed in the incubator overnight, it is felt that a positive diagnosis would have been arrived at earlier.

In order to compare the specific and non-specific agglutinins present, serum was obtained from three of the patients and divided into two parts. One of these was inactivated by heating for thirty minutes at 56° C., and duplicate agglutination tests were put up with the heated and unheated sera. The results obtained were as under :—

	Melitensis	Paramelitensis	Abortus
Case 1—			
Unheated	1/500 ..	1/1,000 ..	1/1,000
Heated	*Nil* in 1/250 ..	1/1,000 Tr. ..	1/500
Case 2—			
Unheated	1/500 ..	1/1,000 ..	1/1,000
Heated	1/500 ..	1/1,000 Tr. ..	*Nil* in 1/250
Case 3—			
Unheated	1/1,000 ..	1/1,000 ..	1/500
Heated	*Nil* in 1/250 ..	1/500 ..	*Nil* in 1/500

Note :—Dilutions lower than 1/250 were not put up.

As soon as a diagnosis of Brucella group was established, blood cultures were taken in an endeavour to isolate and identify the causative organism. Huddleson's media, sloped in large test tubes, was used. Inoculation was

TABLE I.

	Date of Widal	T	A	B	To	2 hours at 56° C.			2 hours at 56° C. and 22 hours at 37° C.			Remarks
		(T, A and B readings are given as "standard agglutinin units")				Melitensis	Para-melitensis	Abortus	Melitensis	Para-melitensis	Abortus	
Case 1 Admitted 23.1.32	1.2.32	32	56	98	1/25	—	—	—				
	8.2.32	28·5	39	98	1/50	—	—	—				
	17.2.32	57	28	63	0	—	—	—				
	28.2.32	32	28	98	1/50	—	—	—				
	11.3.32	32	340	43	1/50	—	1/250	—	1/500	1/1,000	1/250	
	21.3.32					1/500			1/500	1/500	—	Widal for T.A.B. discontinued
	28.3.32								1/1,000	1/500	—	2-hour reading not recorded
	4.4.32								1/500	1/500	—	Dilutions of 1/500 and over only put up
	11.4.32								1/1,000	1/1,000	—	
	18.4.32								1/1,000	—	—	
Case 2 Admitted 27.1.32	7.2.32	11	28	49	—	—	—	—				Organism of the Brucella group isolated on 21.3.3 from blood culture
	14.2.32	32	56	50	—	—	1/250	—				
	21.3.32	32	38·5	200	—	—	—	—		1/125	1/50	
	11.3.32	57	34	125	—	—	1/125	1/125	1/500	1/250	1/500	Widals for T.A.B. discontinued
	21·3.32					1/250	—	—	1/1,000	1/1,000	1/250	
	28.3.32								1/1,000	1/500	1/250	2 hourly reading not recorded
	4.4.32								1/2,500	1 1,000	1/500	Dilutions of 1/500 and over only put up
	11.4.32								1/1,000	1/1,000	—	
	19.4.32								1/500	1l500	—	
Case 3 Admitted 14.2.32	23.2.32	250	385	980	—	—	—	—				Organism of Brucella group isolated 21.3.32 from blood culture
	2.3.32	88	560	490	—	—	—	—				
	6.3.32	130	225	500	—	—	—	—				
	11.3.32	62	225	620	—	—	—	—	1/1,000	1/500	1/250	
	21.3.32						1/500	—	1/2,500	1/1,000	1/250	
	28.3.32								1/1,000	1/500	1/250	2-hourly reading not recorded.
	4.4.32					1/500	1/500	—	1/1,000	1/1,000	—	Dilutions of 1/500 and over only put up
	12.4.32								1/1,000	1/500	—	2-hourly reading not recorded
	18.4.32								1/1,000	1/500	—	
Case 4 Admitted 1.2.32	17.2.32	57	32	73	—	—	—	—				
	22.2.32	57	11	135	—	—	—	—				
	29.2.32	22	11	86	—	—	—	—				
	11.3.32	65	11	195	—	1/250	1/250	1/250	1/500	1/250	1/500	
	21.3.32					1/500	1/500	—	1/2,500	1/2,500	1/500	Mild case. Discharged from hospital
Case 5 Admitted 14.2.32	21.2.32	260	—	195	—	—	—	—				
	28.2.32	450	—	330	1/25	—	—	—				
	6.3.32	198	—	200	—	—	—	—				
	9.3.32	225	—	135	—	—	—	—				
	11.3.32	225	—	195	--	1/250	1/250	1/125	1/1,000	1/500	1/250	Mild case. Discharged from hospital

carried out by the addition of three to four drops of blood to each test tube. Three cases were cultured and four cultures made from each case.

Two tubes of each set of cultures were incubated at 37° C. in the ordinary way, while the remaining two were incubated under increased CO_2 tension for the cultivation of *B. abortus*. Growth appeared in the cultures taken from two of these cases after three to five days' incubation, which, on examination, proved to be morphologically similar to an organism of the Brucella group. The colonies developed with equal readiness both in the tubes incubated under ordinary atmospheric conditions and in those grown under increased CO_2 tension.

Formalized emulsions of the organisms isolated were put up against high titre sera of melitensis, paramelitensis and abortus, and also against fresh and inactivated sera obtained from the patients themselves. The following results were obtained.

(1) ORGANISMS ISOLATED FROM BLOOD CULTURES *versus* HIGH TITRE SERA OF THE BRUCELLA GROUP.

	1/25	1/50	1/125	1/250	1/500	1/1,000
Melitensis (Titre 1/500) ..	–	–	+	+	+	+ Tr.
Paramelitensis (Titre 1/500) ..	–	–	++	++	+	+ Tr.
Abortus .. .. (Titre 1/1,000)	–	–	+ Tr.	–	–	–

(2) HOMOLOGOUS ORGANISMS *versus* PATIENTS' SERA.

	1/25	1/50	1/125	1/250	1/500	1/1,000	1/2,500	1/5,000
(*a*) Serum of Case 1—								
Unheated ..	–	–	–	+	+	+	–	–
In-activated ..	–	–	–	+	+	+	–	–
(*b*) Serum of Case 2—								
Unheated ..	–	–	–	+	+	+	+	+
Inactivated ..	–	–	–	+	+	+	–	–

The organism isolated was thus conclusively proved to be a member of the Brucella group; but there was no definite indication as to the species. The serological results obtained with the patients' serum against known emulsions seemed to point to a melitensis or paramelitensis infection rather than to one of abortus; and the readiness with which the organism grew under ordinary atmospheric conditions supported this belief. On the other hand, the history of infection seemed to point to cows' milk being the source of origin, which suggested an abortus infection.

In order to attempt further differentiation the dye method of typing was tried, using media to which dilutions of 1/10,000 to 1/100,000 of an aqueous solution of gentian violet were added. The results obtained were inconclusive (Table II).

In order to establish definitely the precise organism an absorption test was carried out. A serum of a titre of 1/10,000 was prepared from the homologous organism, and subsequently absorbed with melitensis, paramelitensis and abortus emulsions, as well as with the homologous organism. The absorption dose selected was 25,000 million per cubic centimetre.

This dose was decided upon in view of the findings of Wilson and Miles, who demonstrated that the component parts of the antigens of the Brucella group were common to all members, varying only in their relative proportions. By using this dose it was hoped to decrease sufficiently, if

TABLE II.—RESULTS OF GROWTH ON LIVER EXTRACT AGAR TO WHICH A SATURATED AQUEOUS SOLUTION OF GENTIAN VIOLET IN DILUTIONS OF 1/10,000 TO 1/100,000 HAS BEEN ADDED.

	1/10,000	1/20,000	1/40,000	1/80,000	1/100,000	Agar	
Melitensis ..	–	–	–	+	+	+	24 hours incubation
Paramelitensis ..	–	–	–	+	++	++	
Abortus	–	–	–	–	–	+	
X	–	–	–	+	+	++	
Melitensis ..	–	–	–	++	+	+++	48 hours incubation
Paramelitensis ..	–	+	++	+++	+++	+++	
Abortus	–	–	+	++	–	+++	
X	–	–	–	+	+	+++	
Melitensis ..	–	–	–	++	+	+++	72 hours incubation
Paramelitensis ..	–	+	+++	+++	+++	+++	
Abortus	–	–	+	++	–	+++	
X	–	–	–	+	+	+++	

not to remove entirely, the agglutinins of the specific organisms so as to make final differentiation possible. The results obtained on agglutination against the homologous and heterologous organisms are shown in Table III.

From these results it appeared that, in spite of the history of origin, the organism was a paramelitensis strain.

TABLE III.

	Melitensis emulsion	Paramelitensis emulsion	Abortus emulsion	X (homologous organism) emulsion
Control (unabsorbed) ..	1/10,000	1/10,000	1/2,500	1/5,000
X Serum absorbed with melitensis emulsion	1/500	1/2,500	1/500	1/250
X Serum absorbed with paramelitensis emulsion	1/125	1/50	1/50	0
X Serum absorbed with abortus emulsion	1 500	1/500	1/125	1 1,000
X Serum absorbed with X emulsion	0	0	0	0

Further inquiries showed that goat's milk could not be definitely excluded as the source of infection. The procedure outlined above was that normally followed; but it was also reported that during the period in question a certain amount of milk was sold by itinerant milk vendors, particularly among the families of the unit who found the vendor's prices cheaper than those of the authorized contractor, and doubtless also to those soldiers who subsequently developed undulant fever. The absence of any cases among the families may be satisfactorily accounted for by the fact that they usually boil their milk, not from a hygienic point of view, but to prevent premature souring.

REMARKS ON MYOSITIS OSSIFICANS.

By Major MANFRED MORRIS,
Royal Army Medical Corps.

The writer offers his apologies to readers of our Journal for being unable to throw any new light on this well-known condition, but he feels that many medical officers will find themselves in a position to save their patients considerable trouble and pain if attention is drawn to the ætiology and treatment of this by no means rare complication of injuries involving the elbow-joint, so common in the Service.

I am unable to give a better description of typical cases than to repeat the remarks of the late Sir Robert Jones.[1] He was of opinion that this alarming condition may arise after any fracture about the elbow, but is most commonly associated with dislocation of the elbow backwards. Its onset is gradual, and, when established, may result in a complete or partial ankylosis of the elbow-joint. It is generally due to tearing of the muscular and periosteal tissue from bone, accompanied by hæmorrhage. Fragments of periosteum and osteogenetic tissue are pulled away, and probably in this way the formation of new bone takes place along the interfibrillary and intermuscular septa. The symptoms are insidious. An elbow which is doing well begins to get stiff in the third or fourth week, and, if an X-ray film is not taken, passive movements may be prescribed. This is a dangerous procedure. A film will show a suspicious cloudiness about the attachments of some muscle, usually the brachialis anticus. In two or three weeks this shadow becomes more dense, and traces of bone structure are noted. It is a mistake at this stage to operate, because further osteogenesis often occurs. The elbow should be kept quite still until evidence is obtained that bone deposit has ended, a fact which is easily ascertained by successive radiograms, and then only should active movements be allowed. In rare instances the bone may be completely absorbed, but in many cases only partial absorption occurs. If the deposit remains and is inactive, but causes disability, it can now be removed, but if the movements of the elbow are free it should be ignored. These deposits may remain for many months, sometimes years, and ultimately be absorbed.

While, therefore, we have every right to expect a good result from injuries of the elbow, we should be alive to possibilities and dangers. We should carefully note any nerve involvement at the moment of injury ; we should speak of the possibilities of myositis ossificans, and warn patients of the dangers of energetic massage and movement campaigns.

We should also recollect that the surgeon is not necessarily to blame if an ischæmic palsy occurs ; it may have nothing to do with tight bandaging, and it has occurred without flexion of the elbow, without splints, and without bandaging. At the same time we should, if we can,

[1] Jones, *Brit. Med. Journ.*, April, 1932.

prevent pressure from within by reducing displacements which cause acute venous obstruction, and avoid pressure from without. By no argument can the surgeon be held guilty of the origin of a myositis ossificans, and neither can he be blamed for its development, provided that he does not prescribe passive movements during the period of bone formation. If myositis ossificans appears and any error is to be made let

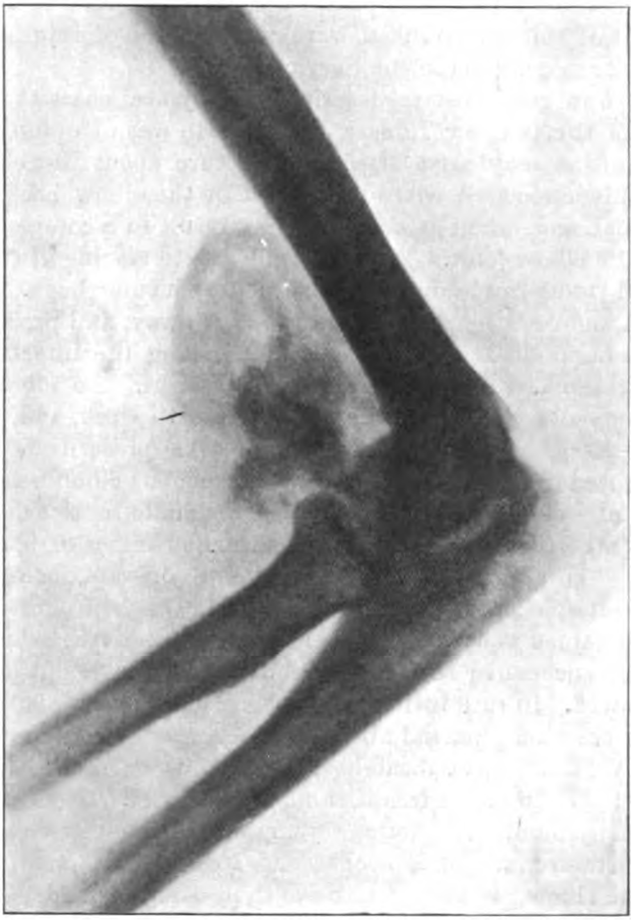

Fig. 1.—Elbow-joint, fourteenth day.

it be on the side of rest. Finally, do not fully flex an elbow without first reducing the fracture or displacement, and, having flexed the elbow, do not obstruct the circulation of the arm by bandaging it in the flexed position.

During the last year my attention has been drawn to no less than five cases of injury to the elbow-joint, which, on examination, were found to be suffering from limitation of movements of the joint, pain, partial ankylosis

(two cases), swelling, and definite bone deposits in the flexor aspects of the arm just above the ante-cubital fossa lateral to the internal condoyle. In all these cases the trauma was trivial (except one, who had a typical dislocation backwards—reduced immediately without difficulty) resulting from falls at football on the elbow or on the outstretched hand. As is almost invariably the case in the Service, these cases were X-rayed during

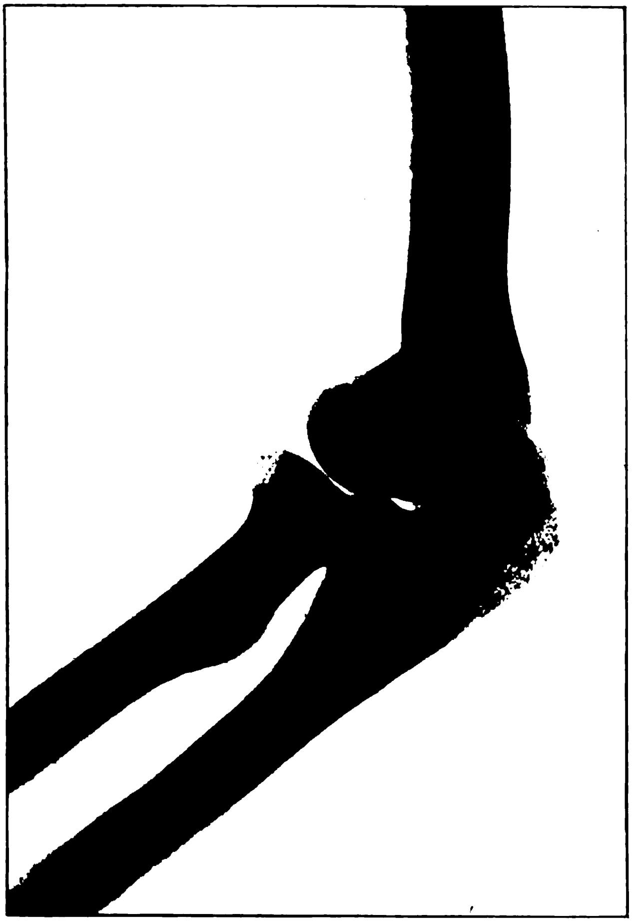

Fig. 2.—Elbow-joint, thirty-fifth day.

the first three days after the accident and in each case no bone lesion was demonstrated. The cases were treated by putting the affected limb in a sling and applying lead and opium lotion. Massage and radiant heat were commenced about the fourth day. My earliest case of myositis ossificans commenced with typical symptoms, and radiological evidence of bone deposits was visible on the tenth day; my latest on the sixteenth day after injury (the dislocation case). The photographs represent one of the typical

cases out of the five as seen on the fourteenth day, and on the thirty-fifth day after treatment.

The condition when it arises is definitely an alarming complication. Starting as a case of trivial injury with a negative X-ray (if taken), one is suddenly confronted with a problem of threatened ankylosis and grave disablement.

I treated these five cases by complete fixation and rest for three weeks. Two of the cases were put in plaster with the elbow at a right angle, and the other three placed on external angular splints. In four out of the five cases, the bone deposits were almost completely absorbed after a month's rest, and the fifth case, the most obstinate, commenced to improve after six weeks.

I have not had a case in which operative treatment was indicated, and have not seen the condition in any other part of the body except in the brachialis anticus muscle.

I consider that the lesson to be learnt from these cases is to go very easy as regards movements and massage in the early days after injuries to or near the elbow-joint, and further, that on the slightest suspicion of myositis ossificans arising, the limb should be immediately placed at complete rest and the elbow-joint immobilized at a right angle. I would lay stress on the fact brought out by my cases, and not generally described or mentioned, that the condition may arise after trauma in which there has been no apparent or radiologically demonstrated bone injury, as well as by gross fractures and dislocations. The length of time the joint is immobilized must be judged chiefly by frequent radiological examinations.

My thanks are due to Colonel J. W. L. Scott, D.S.O., for permission to send these notes for publication, and to Assistant Surgeon P. F. D'Mellow, I.M.D., for the radiograms.

Travel.

BEYOND LEH.

A SHOOTING TRIP IN LADAKH, 1926.

Being a Diary kept by

K. W. DICKSON, F.R.G.S.

(*Continued from p.* 144.)

XII.—In Number Sixteen Block.

Kiamjun, Tuesday, May 14, our shortest march, only nine miles. We arrived at 9 a.m., and pitched camp in a very sandy field. It was rather exciting feeling we had actually arrived on the ground where R. could shoot. The camping ground was like any other, but there were high precipitous hills on three sides, and only a narrow opening where a little stream came down to join the Indus. It was up this opening that R. had

planned to go next day. A channel was cleverly built round the hillside but there was a break in it just above us, and the water came tumbling down about twenty feet, and incidentally it was very useful for our camp. Between us and the Indus was a huge boulder fifty feet high; the top was at an angle of forty-five degrees, but the ruins of an old castle, probably hundreds of years old, still remained in a very precarious position on the very top. One heavy shower of rain would have brought the whole ruin to the ground.

We had brilliant sunshine for about two hours after we arrived, then dark clouds came up from the south, and in a few minutes it was snowing on all the hills around. A tearing wind came down the valley until I thought the tents would blow over. Khazir But wanted R. to take a tent and bedding and food for two or three days, and camp as far up beyond Tangyan as possible. As it would probably be very cold, and as they took no beds, R. thought it better that I should stay with the servants and the dogs; I didn't appreciate being left in such a closed-in desolate spot. I had brought my paint box, but the view was not inspiring; still I thought I might be driven to try a sketch even of desolation if R. stayed away too long. It was a great chance to get washing done; parasites had been very troublesome, a variety I had never seen before; in spite of a daily bath and search in garments, they persisted. I thought if there were many Britishers in Ladakh, Mr. Keating would be as wealthy as Mr. Ford, but even insect powder was little use; I had to put garments in a solution of perchloride of mercury.

The few willow trees here were not even showing buds. It was bitterly cold at night and during the day when the sun was not shining. R. let his bath towel fall into the basin of hot water, then hung it on a tent rope to dry; it was frozen stiff in a quarter of an hour, and had to be packed with the lunch basket, so as not to wet the bedding.

Burrhel had been seen in the hills near, and although no large ones had been reported, they were probably not far off. R. left next morning at break of day to go up the valley. One yak went with them, laden with tent, bedding, and provisions for three days in the tiffin basket. Garry and I accompanied R. about a mile; there were literally dozens of chikor about. I very reluctantly parted from R., thinking at the last moment that the cold could not possibly be worse than those days coming up the Zoji La. Still I was so keen for him to have every chance of a good head, that I might have been a hindrance in some unforeseen way.

I found a nice seat among the great boulders overlooking the camp, and had writing materials with me; Kelpie came beside me, but Garry was enjoying himself pretending he was a lion, as he chased interested Ladakhis away from the tents. It was a perfect morning, like a September day in Scotland, only the sun was much warmer. I felt stiff sitting so long, and wandered down to the tents where Jit Ram was having a field day with the washing.

I was busy washing my hair when a Ladakhi, coming down the path with a yak, to my surprise handed Jit Ram a note. This was from R. to say they had pitched the tent at the top of the nullah beside a village, and there was no reason why I should not take my bedding and go up for the night. This was cheery news indeed. I had still three letters to write and an order to the postmaster at Leh for Chota Subhana to get our letters, as we were sending him off that day. Leh was our nearest post office, and the journey would take him six days. I wrote quickly while Jit Ram and khansamah packed up my bedding and it was put on the yak's back. I had not thought of taking a camp bed, but in any case I did not want Khazir But to think I could not sleep on the ground if the sahib could. I had no watch, but imagined it was about 2 o'clock when I got to my destination ; it was a very hot rough climb of about six miles. Only Garry had come with me, as Kelpie stayed behind with the servants to look after our kit. There were several names of villages in this valley marked on our large scale map, but these turned out to be one or two houses, a few chortens, and perhaps a water prayer wheel. Garry had to be kept in to heel as there were goats and sheep everywhere, and across the stream I saw a few yak calves, shaggy little animals, frisking about like huge black lambs. I had buoyed myself up with the thought of tea on arrival, only to find that by some mistake all the provisions and cooking utensils had been sent with R. Here was the shikari's son, who had been brought specially to cook, with nothing but a paraffin tin full of water, no food, no kettle, no tea. I was rather unreasonably cross with the boy. I had brought up a small tin of milk with me, so had the water boiled, and in about half an hour had two or three cupfuls of hot water with a little milk in it. I never knew before that water and milk could taste so good. Mahamdoo, this Kashmiri boy, the son of the shikari, was always being thrust forward, and our own servants kept in the background. He had a way of marching about two paces behind us which irritated us both. He was in fact a quite unnecessary extra servant. A well-known habit of the Kashmiri is to bring as many of his relations as possible in the service of a sahib. When the boy first appeared we thought he was the tiffin coolie, but when I proposed that he should take the letters to Leh and collect our mail, his father had excuses ready at once : he was a Mussulman and would not be understood, etc. I found out from the khansamah that they were all of the same religion. However, the boy was taken up the nullah "to cook," and Chota Subhana was sent off with the letters.

The only tent, a single fly, was pitched on flat ground close to the last houses at the top of the valley. A rough path branched off on either side of a high hill straight in front of us, one leading to Gun Pass. The shikari and coolies found a lodging in the nearest hut, where grain was usually stored. They had a fire of scrubby heath—the only firewood in this district; there were no trees so high up.

Snow began to fall within an hour after I got up, and the ground was

white before R. and the shikari returned. They were like snow men; however, most of it shook off and it was not like rain. We had tea at once, while I heard about their doings. They had followed a stream to the north-west, and climbed to about 17,000 feet, when the local shikari, looking over the shoulder of a hill, pointed to four burrhel; two large and two small, as he said in broken Hindustani. They were on open ground, lying on rocks contentedly chewing the cud. R. said he could see their mouths moving as he watched them through the telescope. They were in full view but out of range, with no sheltered way of approach, bare hillside with no cover. The men reluctantly came back to camp as snow had begun to fall.

It snowed all evening and most of the night. We were fairly comfortable sleeping on the ground, as it was not wet under the tent. Next morning there was an inch or two of snow all round us, and the hills straight above us glistened in the morning sun. There were a great many big dark clouds about, so it was no use going after burrhel unless it cleared. By half past seven it had cleared and the snow had begun to melt; Jit Ram and the sweeper arrived from the lower camp as the sun was shining, and I set off back to camp with them to bring up more food and writing materials. It was perfectly lovely and sunny, blue sky and fleecy white clouds. As I strode down hill I thought the weather had now settled and that R. had gone up the Pass and would probably get a fine burrhel.

It was good to be alive that morning. Khansamah and Kelpie gave me a great welcome, and khansamah made me a cup of coffee while I gave out stores. Then I had what was a luxury up there—a good hot bath in the canvas tub, while the air was warm outside. Our baths had been rather a mixed pleasure for some time, as the thermometer was so low, and towels very chilly if not frozen.

Khansamah had cooked the hare shot the day before and gave me a piece of it for tiffin; it was one of the best lunches I have ever eaten. The remainder was packed in a linen ham sack with the other provisions, which the pony man strapped to his back, and we started off up the hill. A perfect afternoon it seemed. As I had the gun, we looked about for pigeon and chikor, and saw a few, but too far away.

A lama in his red robes came up on a pony just behind us. I expected lamas to be clean ;. I was wrong. I stopped to listen to a prayer wheel being turned by a water wheel in a little shelter over a stream. When the pony man saw I was interested, he took me to where I could see inside; a very primitive arrangement—thousands of prayers packed into the little wheel, which had wooden teeth fitting into the teeth of the water wheel. I thought as I climbed the hill that if I were starting a new religion I would have a wheel too, but it would be a wheel of kindnesses. I often feel when someone has been specially kind to me that I must go and do something for someone else at once—almost a superstition, I suppose, about keeping the wheel going round. It would be as good as the Boy Scout's daily kind deed, because the kindness would be done when the heart was warm with gratitude.

Garry had again to be kept in hand. I was surprised at the number of fine black yaks I saw that day; a herd stood about, scraping the snow with their broad hoofs to get at the short grass beneath. The sky began to be overcast, and in a few minutes snow was falling heavily. Luckily I had a waterproof, but it was bitterly cold, and my hands felt frozen. I thought of R. being caught in the snow far up the hills; our camp must have been at an alititude of 14,000 feet.

The pony man was at first very afraid of Garry. I tried to find out the word for dog in Tibetan; having learnt the word for pony, I pointed to it and said "sta," then to the saddle and said, "stega," then to Garry and looked at him; his face lighted up, and he said "kee," then kept repeating "Garree, Garree" to himself. When another sahib brings a dog to that nullah, he will certainly call it Garree! Then he pointed to a large mani stone and said "Mani." I said, "Om Mani Padmi Hum," and he beamed and said it again. We passed a very primitive plough on the ground, and he said "Showee." He had such a nice intelligent face although he was not too clean.

We could not see far ahead for the snow. When we got near to what we had been calling the Tinkers' Camp, our one old tent with no beds, table, chairs, bath or basin, to my surprise there was R. standing beside the tent, and I called out, "What luck?" He had never been out at all. It had snowed all day, although six miles below I had had the most perfect weather imaginable. However, we were quite cheery. I had brought up plenty of food—the cooked hare and enough potatoes; and we had great hopes for good weather on the morrow. It was bitterly cold going to bed that night. The shikari wakened us at half past four to say it had been snowing all night and snow was still falling. We had spent a miserable night. The ground was so hard and was so damp, we had thin wadded quilts but no mattresses. We could not keep warm, and R. slept even less than I did. We were glad to be wakened, and had tea at once, then breakfast, bacon and eggs, about 6 o'clock.

Chikor were tame that morning and came within range of the tent, so R. got dressed and went out with the gun.

After talking it over, we decided to send Burra Subhana down to the lower camp and bring everything up, as double fly tents and camp beds would make a difference to our comfort, and it seemed as if we might remain a few more days. The shikari made arrangement for eight yaks. Burra Subhana could be most easily spared if R. and the shikari went up the hill, and he knew all about loading up.

We had lunch about 11 o'clock, and after that the sky was so clear that Khazir But suggested going up the stream to the N.E., the path that led to Gun Pass. Off they went, R. with his fur cap and gloves, and some chocolate in his pocket. The local shikari, a wild looking little man with a cheery face, carried R.'s coat. I sat and wrote the diary with the gun beside me, but no pigeon came near. I helped to move our kit over to a

more sheltered place, and very soon I heard Mahamdoo saying the baggage was arriving. Kelpie spotted me sitting on a dike, and nearly ate me up, he was so pleased to see me. We all worked hard for an hour, getting tents pitched, beds made, and everything put in its right place as quickly as possible, as it had become very cold, and looked as if a big snowstorm was coming any minute. I mended socks and sewed on buttons until my back ached with sitting on the edge of the bed with no back rest. Oh, for a comfortable chair!

The party from the hill arrived back about half past four, not even having seen a burrhel; it was most disappointing. We had tea at once, hot drop scones and raspberry jam; then R. had a bath and shave before dinner, and so to bed by 7.30. R. peeped out of the tent flap several times in the night and saw the stars although hazily, so we were prepared when Jit Ram brought tea and eggs for him at 4 o'clock. I sat up and prepared his lunch: coffee and milk, buttered scones and cheese; nothing more solid at that altitude. They were away by half past four. I was so sleepy and tired that for once I didn't get up. Jit Ram brought me a hot bottle, and with Garry and Kelpie snug in the tent, we slept until seven, dozed until half past eight, and had a bath and breakfast about nine—a real Europe morning. Unfortunately my watch was broken, but R. left me his, so I knew how late it was. It was a glorious day, and I felt as if they were having good sport.

I had a great washing of woollies; it is extraordinary how quickly even thick woolly garments dry at this altitude when the sun does shine.

The day before Khazir But told me a man was leaving the village for Leh, so I hurriedly wrote a letter and gave it to him to post, as we might not have had another chance of posting for a fortnight.

(*To be continued.*)

Current Literature.

Koschkin, M. L. **An Inquiry into the Mechanism of Chlorination with Pre-ammonisation.** *Zeitchr. f. Hygiene u. Infektionskr.* 1933. cxv. Part I, 99-109.

The author considers that the action of chlorination following on pre-ammonization is not clear. The increased bactericidal power and prolonged action of the process are generally attributed to the formation of chloramines of types NH_2Cl and $NHCl_2$. Koschkin found that the addition of ammonia before chlorine lessened the capacity of the water to absorb chlorine, but increased its bactericidal capacity. The addition of the ammonia at the same time or after the chlorine had not the same effect. Koschkin states that the increase of the bactericidal action of chlorine following pre-ammoni-

sation is not due to the formation of chloramines, NH_2Cl or $NHCl_2$. He considers the results might be explained on the assumption that the ammonia combines with substances which have thus lost the power of absorbing chlorine. In the experiments the proportion of ammonia to chlorine was $\frac{1}{2}:1$.

The addition of ammonia to water containing phenol before chlorination renders the chlorine-binding power of the solution very much less (e.g., with 0·2 g. phenol it is about 110 times smaller). The prevention of the chemist's shop smell and taste is considered to depend on this reduction of the chlorine-binding power. The addition of ammonia at the *same time* as the chlorine, or *after* the chlorine, did not prevent the development of the chemist's shop smell and taste.

DR. LEOPOLD FREUND. **Healthy Tanning of the Skin and Prevention of Sunburn.** *Wiener Klinische Wochenschrift.* No. 25. 1933, June 6, v, 46, p. 778.

For many centuries very little importance was attached to the influence of sunlight on the life and health of the human race. Only a few keen observers and physicians advocated its health-giving properties, but their voices were unheeded. Modern opinion, on the contrary, mainly in connection with sport, has given rise to a universal, immoderate, and, in general, a confused craze for sun-bathing, the injurious consequences of which are bound to become apparent. This accounts for the great demand for preventive remedies against sun- or snow-burn and other harmful effects of over-exposure to solar rays. In spite of the fact that the scientific methods for shielding the exposed subject from light have been repeatedly explained with all possible clearness by competent experts, not only in the literature of dermatology and light treatment, but also in popular lectures and publications, it is amazing how many erroneous ideas are circulated in periodicals dealing with sport and even in medical journals, and the endless commentaries published in editorial columns.

The inquiry is either: How can I avoid sunburn at the seaside or snow-burn on a climbing expedition? This query is often followed by the words "and yet become tanned."

In order to give a correct answer to these questions we must first realize the respective causes of sunburn and tan. Careful investigations have definitely proved that sun (snow) burn does not cause erythema solare or dermatitis ex insolatione, except by the action of short-wave light, i.e., according to Hausser and Valle, the ultra-violet zone between wave-lengths 310 and 280, and, according to my own experiment, the violet and ultra-violet zone between 397-230. The skin is not, however, bronzed solely by the action of the short-wave light sector. It is beyond doubt that the visible, long-wave rays of light and heat contribute to the formation of pigment, or at least, stimulate the pigment-forming action of short-wave light rays (see W. Hausmann, J. Kowarschik). *Moreover the skin may be*

tanned without any previous inflammation symptoms (see L. Freund, Franz Peemöller, Jüngling).

When an individual whose skin possesses average sensitiveness to light wishes to be sunburnt without unnecessarily irritating his skin by exposure he should simply apply an ointment, allowing both long and short wave-light rays to penetrate, but which so weakens the latter that their reduced intensity will not cause inflammation of a normally sensitive skin. The following remedies, some of which contain specific quantities of opaque substances in powder form, are very generally used; lard, butter, vaseline and many other equally valuable preparations. All these substances are, to a certain extent, efficacious, that is to say, so long as the period of exposure and intensity of the rays do not exceed a given limit and the exposed subject is not abnormally sensitive to the action of light, i.e., his skin has not already become inflamed by exposure to short-wave solar rays of low intensity. In the case of great sensitiveness to light, or when the skin has been exposed for a considerable time to intense ultra-violet-rays, for instance, at high altitudes above sea-level, these remedies are bound to fail, since they do not afford sufficient protection against harmful rays. Consequently, when making use of such ointments, and notwithstanding their moderate protection against the rays, slightly increased by substances produced by the action of light on the epithelial cells, the skin will become a *deep brown*, because these remedies allow not only the long-wave, but also a comparatively large number of short waves to penetrate; the latter, in this case, contributing very actively to browning of the skin. The skin pigment thus produced gives little protection against the sun's ray (A. Rost. C. With, &c.).

Other preparations, for instance naphthol-disulphonic acid in the form of "Antilux" ointment and "Aesculine" preparations, such as "Ultrazeozon" ointment, are highly efficacious for protecting the skin against the short-wave spectral zone, which irritates the skin (Aesculine up to wave-lengths 390, and naphthol-disulphonic acid even up to the beginning of violet-wave length 410). Therefore, when these preparations are used, the spectral zone cannot be taken into account in tanning of the skin. For instance, because Antilux ointment allows the visible and radiant solar rays, which, as already stated, are instrumental in bronzing the skin, to penetrate freely, it does not in any way prevent the epidermis from becoming moderately tanned. Undoubtedly, when these preparations are used, their protective action against the skin becoming tanned is very evident. They afford remarkably effective protection against light, not only to normally sensitive skins, but also to those whose skin is most sensitive to the special area of spectral light. In support of this claim, we will quote the following communication from the Italian Alpine Club, which is of interest, because, to my knowledge, it is the first report on experiments in protection against the sun's rays at so great an attitude above sea-level:—

"You very kindly provided the Alpino Italiano Club, Trieste Branch, with some 'Antilux' for their Caucasus expedition.

" I myself and the other members of the expedition used this preparation with the very best results, notably on the west peak of Elbruz, which is 5,629 metres high. At this altitude, the action of the solar rays, as registered by the actinometers, is about twice as intense as on Mont Blanc, the highest peak in Europe. In spite of these conditions, your preparation was fully effective, and not one of the members of the expedition suffered in the slightest degree from sunburn. I should like to thank you very much on behalf of the Alpino Italiano Club.

" *Trieste.* Yours truly,

" *January* 27, 1930. (Sgd.) Vladimiro Dougan."

The period during which the body may be exposed to the sun's rays, with beneficial effects, varies according to the specific purpose for which the treatment is given. Diseases such as alopecia areata, rickets, rheumatic and gouty affections, asthma, tuberculosis, etc., are only favourably affected by erythema-developing doses of sunlight, the amount of which must be left entirely to the discretion of competent medical advisers. The quantity of light required for the normal welfare of the body is very much smaller, and it is well known that, in the normal individual, there is no need to develop light-erythema. Extensive researches and observations have definitely established the fact that the deepness of the tan on the skin produced by exposure to the sun is no guide for determining the period of exposure beneficial to health. According to clinical experience, the tendency to make the skin as deep a brown as possible is in no way justifiable, and is simply inspired by the fashion of the present day, against which there is no need to wage a scientific controversy.

In 1931, E. Urbach and J. Konrad discovered a rarely-occurring skin disease of the same type as Hutchinson's prurigo æstivalis, due to the ultra sensitivity of the skin to the yellowish (long-wave) solar rays. In the treatment of this disease Antilux and Ultrazeozon preparations were not found to be an efficacious protection against the rays. By the internal use of resorcin, or by employing it in the form of ointment or paste, Urbach and Konrad were able to combat this skin disease, which is attributable to the long-wave yellow to red solar rays (see *Strahlentherapie*, vol. 32, No. 1, p. 193).

Brown, E. W. **Carboxide Gas: A New Insecticidal Fumigant for Bed-bugs and Cockroaches.** *U.S. Naval Med. Bull.* 1933, xxxi, 3, 253.

The author of this article, Captain E. W. Brown, of the U.S. Naval Medical Corps, places under three heads the usual methods of exterminating insect pests: (1) Contact insecticides; (2) stomach insecticides, such as insect powders containing arsenicals, etc.; and (3) flaming. He considers the first two methods unsatisfactory and of temporary value only and the third is usually limited in its application.

On the other hand, a gas tends to be the ideal process in that it expands

to all available spaces, and on account of its penetrating powers. Hydrocyanic acid gas is, however, highly toxic both for man and insects and great precautions must be observed in its use. Carbon bisulphide and sulphur dioxide also have undesirable characteristics, the former owing to its explosiveness and inflammability when mixed with air in concentration suitable for insect destruction and the latter on account of its deleterious action on fabrics, paint and metal.

An insecticidal fumigant which does not possess these undesirable characteristics, and known as ethylene oxide, has recently been brought forward by a commercial firm in America, and is marketed in steel containers under pressure, resembling the ordinary oxygen cylinder. The fluid has a faint but distinct ether-like odour.

Various investigators have studied the insecticidal value of ethylene oxide and their work showed that: (*a*) One pound per 1,000 cubic feet in a fumigation vault in twenty hours, the temperature ranging from 60° to 70° F., completely destroyed an assortment of moths, beetles and weevils, contained in cotton-stoppered glass vials buried in various situations; (*b*) two pounds per 1,000 cubic feet with twenty-four-hour exposure, at a temperature of 75° to 80° F., killed adults and larvæ of flour beetles, and larvæ of meal and clothes moth, by relatively deep penetration; and (*c*) one pound per 1,000 cubic feet with an exposure for twenty-four hours at 75° F. exterminated larvæ of the clothes moth, the carpet and the furniture beetle, the larvæ being contained in cotton-stoppered vials and buried in over-stuffed furniture.

The disadvantages of ethylene oxide are that in certain concentrations it is also combustible and explosive when mixed with air. Other workers had found, however, that a mixture of ethylene oxide and carbon dioxide in a ratio of one part of the former to 7·5 parts of the latter by weight is non-inflammable, that the two compounds are of practically the same vapour density and that the mixture does not separate or stratify.

Further, it was found that carbon dioxide practically doubled the insecticidal power of ethylene oxide, and in experiments to determine the dosage required to kill all types of insects infesting various food products, it was ascertained that in the presence of carbon dioxide the dosages never exceeded one half of that for ethylene oxide alone for the same period of contact.

The mixture of carbon dioxide and ethylene oxide is now known by the trade name of Carboxide and is supplied compressed in cylinders in liquid form in the ratio of one part of ethylene oxide to nine parts of carbon dioxide by weight.

Although there were no published data, it was believed that ethylene oxide alone or used as carboxide would be just as effective against bed-bugs, cockroaches, fleas and lice as against the types of insects already mentioned. A research was therefore instituted at the naval supply depot, Brooklyn, N.Y., to ascertain the minimum lethal dosage of carboxide for bed-bugs

and cockroaches under practical deep penetration conditions. The tests were carried out in a practically airtight chamber 18 feet long, 10 feet wide, and 11 feet high, of a cubic capacity of 1,980 cubic feet. An illustration of the chamber is given; it had one window of reinforced glass, with walls and ceiling coated with shellac and the door was provided with a special type of rubber gasket. A motor blower, also illustrated, operated from outside the chamber, caused mixing of the fumigant, and, by means of valves connected to the exterior of the chamber, a rapid clearing of the fumigant could, when necessary, be effected.

For setting up a definite concentration of carboxide, the door was first securely sealed. The cylinder of carboxide was then placed outside the fumigating chamber on scales, which were adjusted to the weight of carboxide it was desired to release. The inlet pipe was about three-quarters of an inch internal diameter and it discharged into the chamber at a short distance above the floor. The discharge end of the inlet pipe was enclosed in galvanized iron casing, open above and below. The requisite amount of gas was allowed to enter quickly, the blower was immediately brought into use and the air of the chamber re-circulated for the first thirty minutes of the experiment.

In the great majority of the tests the insects were contained in large-sized pill boxes, the covers being perforated with pin holes. The boxes were placed in every conceivable position in the chamber, such as in clothing, a bag of rags, mattresses, drawers of furniture, pockets of a coat, etc., selected with a view to requiring from a moderate to a high degree of penetration for the fumigant to reach the insects.

The test-boxes for each experiment varied in number from four to ten and the number of insects in each box averaged six and seven. At the end of the experiment the chamber was ventilated by means of the blower and five minutes later the boxes were removed, the number of dead insects recorded and the boxes incubated over night at a temperature of 74° F. To determine final results the insects were inspected the following morning at 9 o'clock. The temperature of the fumigation chamber was recorded during each test, the chamber being heated by means of a steam radiator. Controls in approximately the same number of containers and the same number of insects per container were kept outside, but in the vicinity of the chamber. They were incubated at the conclusion with the test insects and a record of the fatalities was made the following morning.

Two tables are published, one for the test with carboxide on bed-bugs and the other on cockroaches. These complete tables give the position of the box containing the insects, time of exposure, concentration of gas, position of insects, temperature, number of controls, number of controls dead and immediate lethal effect.

Bed-bugs.—The periods of exposure to carboxide varied from three to twenty-four hours.

In the three-hour exposure the concentration of gas varied from a

maximum of 15 to a minimum of 2 pounds of carboxide, and complete destruction resulted down to a dosage of 5 pounds ; four tests at 4 pounds were indeterminate in results ; and with 2 pounds all the insects escaped.

In the six-hour exposure destruction was complete for all concentrations employed, i.e., 12, 9, 6, 4 and 3 pounds.

In the twelve-hour exposure, at concentrations of 4 to 3 pounds, all experiments were successful in killing the insects.

In the eighteen-hour exposure, with concentrations of 10, 7½, 5, 2½ and 2 pounds, total destruction of the insects resulted.

In the twenty-four-hour exposure, in concentrations of 2½ and 2 pounds, destruction was complete.

Two additional control tests were carried out in which the test boxes of insects were placed for a period of twelve hours in various positions occupied by the experimental group but not exposed to carboxide, and these showed, as did the ordinary controls, that the number of insects succumbing was negligible.

It was noted in the experiments that an increase of temperature up to a certain point had " a stimulating effect upon the respiratory processes and, therefore, in itself increases the susceptibility of an insect to a toxic gas. Such ranges of temperature were recorded in the three-hour tests as 68-70°, 72-74° and 73-76° F.; in the six-hour tests as 71-73°, 72-74° and 76-78° F.; in the twelve-hour tests as 70-72° and 74-78° F. It is concluded that the fumigation of bed-bugs with carboxide proceeds satisfactorily at temperatures of 68° and above."

Cockroaches.—Owing to difficulty in procuring cockroaches, fewer experiments were carried out with these insects than with bed-bugs, but from the details given in the table it is concluded that the cockroach like the bed-bug is susceptible to the toxic effect of carboxide.

The mortality of the control insects was again negligible.

In a discussion regarding the destruction of the eggs of the bed-bug and cockroach, the author considers that for the bed-bug egg it is probable that a single fumigation with the dosage of the minimum lethal order for the adult will be adequate, although this has not been experimentally established. In the case of the eggs of the cockroach it is considered that the capsule will offer increased resistance to penetration in contrast to that of the bed-bug egg and it is probable that a minimum lethal dosage for the adult stages of the cockroach will not kill the eggs and that a second fumigation will be required at the end of ten days to destroy the newly-hatched insects.

After summarizing the results of the experiments, the author recommends for the destruction of both bed-bugs and cockroaches the following minimum lethal concentrations of carboxide per 1,000 cubic feet in a relatively air-tight space : 5 pounds for three hours, 3 pounds for six hours, 3 pounds for twelve hours, 2 pounds for eighteen hours, and 2 pounds for twenty-four hours.

Captain Brown concludes this interesting and important article by saying that "Carboxide gas is non-inflammable and non-explosive; non-injurious to fabrics, furniture, or food products; of about $\frac{1}{37}$ to $\frac{1}{80}$ of the toxicity of hydrocyanic acid gas for man; and is not prohibitive from the standpoint of cost."

MASCALL, W. NEVILLE. **The Pathological Diagnosis of Female Gonorrhœa.** The *Lancet*, 1933, ii, 233.

This paper contains an analysis of the results of investigations made on 500 consecutive cases of gonorrhœa at the London County Council Clinic, Whitechapel; the methods employed being smears, culture and complement fixation. Smears were made from the urethra and cervical canal, and were stained by Jensen's modification of Gram's method. Gonococci were diagnosed in 227 cases, and in 49 of these culture and complement-fixation tests were negative. Cultures were made on hydrocele agar (pH 7·5), the oxidase reaction being employed to help in the recognition of the organism. Culture was positive in 334 cases, and in 156 of these the other two methods were negative.

Complement fixation tests gave results slightly inferior to those obtained on culture, but better than those given by examination of smears. It is stated, however, that the method of performing the test now employed gives a higher proportion of positives than did the method used during the investigation. 293 cases gave a positive reaction at the time of their first inspection, and subsequently 50 of the negative cases became positive. 142 cases giving a positive reaction were negative by the other two methods of examination. In twenty-five cases in which the complement fixation reaction was positive there was no clinical evidence of the disease, and cultures and smears were negative. The author considers that these were latent cases of gonorrhœa, although he admits that some of them may have been cases of cross-infection. This, however, is a rare condition of which the author has seen only five cases, the reactions being due to the presence of *Micrococcus catarrhalis* and *M. flavus* in the naso-pharynx. The clinical history has to be carefully considered in estimating the results of a complement-fixation reaction. The author recommends that whenever possible the three methods should be employed to assist in the diagnosis of gonorrhœa in the female.

Reviews.

Annual Report of the Surgeon-General, U.S. Army, 1932. Washington: Government Printing Office.

The Surgeon-General of the United States Army, in his report for 1932, deals with the general activities of the Medical Department for the year ending June, 1932, and with the vital statistics of the Army for 1931.

The average daily strength of the Army was 135,425, a decrease of 1,874 from the strength in 1930 and 535 from that in 1929. There were 11,548 officers, 112,814 white enlisted men, 3,764 coloured enlisted men, 6,287 Filipinos, and 1,012 Porto Ricans. In addition, there were 896 members of the Army Nurse Corps, including reserve members on active duty.

The commissioned medical personnel consisted of 1 major-general, 2 brigadier-generals, 75 colonels, 98 lieutenant-colonels, 551 majors, 137 captains and 91 first lieutenants, a total of 955 officers. There was a deficiency of 28 officers, and it is noted that in 1931 there were 99 captains and 122 first lieutenants, while in 1932 the numbers were 137 and 91 respectively. The Surgeon-General states that the comments made in several previous reports on the insufficient strength of the Medical Corps continue to apply with equal force. He also considers that the Dental Service (155 officers) is inadequate.

In the Veterinary Service there were 119 officers who, in addition to their duties in the prevention and treatment of illness in Army animals, are responsible for the inspection of all meat, meat-food and dairy products offered for Army use.

The ratio per 1,000 of admissions to hospital for diseases was 523·16, and for external causes 131·96, a total of 655·12. The chief diseases causing admission to hospital were: Rhinitis and other diseases of nasal fossæ 52·67, venereal diseases 45·57 (gonorrhœa 26·33, syphilis 11·45, chancroid 7·79), tonsillitis 43·85, influenza 44·47, and bronchitis 38·40.

The ratio for typhoid fever (0·16 per 1,000) was the highest since 1919, the increase being due to the first explosive outbreak since the end of the World War. Eighteen cases occurred in a battery of artillery which had been on the march for ten days in Iowa. All but one of the patients had been inoculated against the disease within "the past three-year period," and the odd man gave a history of having been vaccinated three years previously in civil life. None of the men died. The outbreak was considered to be due to a massive infection of the men on account of neglect of personal hygiene on the march, water being obtained from shallow wells, only one of which was chlorinated; raw milk was used at several places, and some of the seven camp sites were very poor. About sixty per cent of the entire command had diarrhœa at some time during the march.

There were twenty-two cases of epidemic cerebrospinal meningitis with two deaths.

During 1931 there were 6,171 admissions for venereal diseases (45·57 per 1,000), the lowest figure yet recorded. There were 10 deaths from these diseases (9 from syphilis and 1 from chancroid).

The Surgeon-General states in his letter of transmission that the great reduction in the number of cases of venereal disease, from 150 per 1,000 in 1901, is chiefly due to the following measures: education in sex hygiene, periodical physical inspection, adequate treatment of cases, restriction during the infectious period in order to prevent spread to the civil population, forfeiture of pay for absence from duty on account of venereal disease, prohibiting of military personnel from visiting so-called red-light districts, better supervision in the administration of prophylaxis, and, finally, holding the unit commander responsible for the control of venereal diseases in his organization.

There was a great fall in the incidence of venereal disease among the troops in China, the ratio being 53·3 per 1,000 as compared with 282 per 1,000 in 1930. To effect this reduction all known methods of control were used, but special emphasis was placed on the responsibility of officers commanding units for the health of their men. The Departmental Surgeon considers that the good results achieved were due to the action of these officers much more than to the Medical Service.

In Panama there was an increase in venereal disease; there were 911 admissions among the 9,082 troops stationed there, a ratio of 100 per 1,000, although it is claimed that of 115 men who employed prophylactic treatment only 1 contracts venereal disease.

A considerable amount of detail is given regarding the various sections of the Medical Service, and of the work of the schools and hospitals.

There is a brief report on the Library sub-division. The allotment to the library for the year was 19,500 dollars, and it is stated 20,000 dollars annually would be required to keep the collection of literature up to date. The Librarian is a medical officer who has five civil assistant librarians and twenty-one clerks. Seven persons are permanently engaged in research and abstracting.

British Museum (Natural History) Instructions for Collectors. No. 12, Worms. London: 1932. Pp. 22, with 19 illustrations. Price 6d.

This excellent pamphlet is issued by the authorities of the British Museum for the use of collectors. It begins with a brief description of the main groups of worms and then gives valuable information as to their habitat, methods of cleaning and preserving, etc.

Medical interest lies chiefly in the last pages, where the technique of collection and preservation of the parasitic worms is described. The

information is given in a clear and concise manner, and if followed by medical officers when forwarding specimens for identification, the lot of the laboratory worker would be much lightened. H. J. B.

Bacteriophage in the Treatment and Prevention of Cholera. By J. Morison, C.I.E., M.B., D.P.H. London: H. K. Lewis and Co., Ltd. Pp. viii + 32, with 14 Plates (27 figures), and 4 Graphs. Price 4s. net.

In this John Parkin Memorial Essay, Colonel Morison gives a very clear account of the part of the very extensive work on the bacteriophage with regard to cholera, that is being carried out in different laboratories in India and especially in his own in Shillong.

Then after discussing the general problem of cholera in India, the author gives some account of the use of the bacteriophage in combating the disease, but, unfortunately, the results have been very inconclusive. It is an extremely difficult matter to obtain any positive evidence of the value of the bacteriophage as a therapeutic agent, but it is to be hoped that the careful work of Colonel Morison and his colleagues will finally settle, one way or other, this much disputed point.

Massage and Remedial Exercises in Medical and Surgical Conditions. By Noel M. Tidy, C.S.M.M.G., Sister-in-Charge of the Massage Department, Princess Mary's Royal Air Force Hospital, Halton. Bristol: John Wright and Sons, Ltd. 1932. Pp. xii + 429. Price 15s.

This is a work which must have taken an unusual amount of painstaking effort in its preparation for publication. The scope is exceptionally wide and the matter is set out in great detail. It is an excellent reference book for any massage department, and should be the means of making this class of work more interesting for the individual masseur or masseuse who must understand the particular conditions he or she is called upon to treat.

The diseases are fully described under the headings of "Ætiology," "Pathological Changes," "Symptoms," "Treatment." Stress is rightly laid on the correct application of the term "passive movements." On occasion in the past the surgeon in charge of the case has ordered passive movements, and the location of his ward has prevented him from hearing the cries of the patient, submitted to the interpretation of such a loose term by a muscular masseur.

The electrical treatment advised in cases of infantile paralysis (p. 129) does not accord with the teaching and experience of Dr. Cumberbatch, who finds the use of the surging quick sinusoidal current of very great value even in the case of small children. The book makes no mention of such treatment, but states that children are generally frightened and upset by

electrical treatment. A visit to Dr. Cumberbatch's clinic showed young children undergoing this treatment and obviously enjoying every moment of it!

The price of the book (15s.) is very modest for the vast amount of information available.

The print is on the small side for continuous reading, but is quite sufficient for a book of reference.

The illustrations are numerous, well produced and helpful.

W. K. M.

ACIDOSIS AND ALKALOSIS. By Stanley Graham, M.D., F.R.F.P.S., and Noah Morris, M.D., B.Sc., D.P.H., F.R.F.P.S.-Edinburgh: E. and S. Livingstone. 1933. Pp. xii. + 203. 7s. 6d. net.

The authors, who are both connected with the Royal Hospital for Sick Children, Glasgow, deal with a difficult subject in a very able manner. The aim of the book is to give a general survey of the subject and its application to disease.

In the first six chapters the chemical physiology of the conditions is dealt with; this portion of the work requires close concentration on the part of the ordinary reader, for a thorough understanding of its principles is necessary for a proper appreciation of the remainder of the book. This consists of ten chapters dealing with such conditions as diabetes, nephritis, gastro-enteritis, etc., in which acidosis or alkalosis may be met with, the reasons for the disturbance of the acid-base equilibrium, with the symptoms resulting therefrom and the appropriate treatment.

The volume is well worthy of study.

Notice.

PÆDIATRICIANS AND COW AND GATE MILK FOOD.

AT the close of the International Pædiatric Congress held in London, and opened by the Duke of York on July 19, 1933, eighty delegates, including specialists in infants' diseases from fifteen different countries, visited the West Country factories of Messrs. Cow and Gate, Ltd. The factories at Wincanton in Somerset and at Somerton in the vicinity of Glastonbury, were inspected.

It seemed to be the general opinion that the Company had solved the problem of infant feeding not only on the hygienic side, but from the nutritive point of view as well.

No. 5. November, 1933 Vol. LXI.

Journal

OF THE

Royal Army Medical Corps

IN ARDUIS FIDELIS

ISSUED MONTHLY

EDITOR.

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JOHN BALE, SONS & DANIELSSON, Ltd.
83-91, GREAT TITCHFIELD STREET, LONDON, W.1

Price Two Shillings net

VOL. LXI NOVEMBER, 1933. No. 5

Journal
of the
Royal Army Medical Corps.

Original Communications.

ASSESSMENT OF PHYSICAL FITNESS IN THE SERVICES.[1]

BY MAJOR-GENERAL P. H. HENDERSON, D.S.O., K.H.P.

THE ORGANIZATION FOR THE ASSESSMENT OF PHYSICAL FITNESS.

So far as I am aware the organization for the assessment of physical fitness of entrants to the three Services is much the same, except that in the Royal Air Force, where special standards of fitness for flying are required, each candidate who is to fly is examined by a board of specialists including surgical, medical, eye, ear, nose and throat and neurological specialists, under a chairman who correlates their opinions.

As you will appreciate, for flying a man requires to have perfect vision and to be A 1 in other respects, but our source of supply does not permit of this standard being attained for the Army or for the non-flying branches of the Royal Air Force.

The organization in the Army is as follows :—

Standards of physical fitness considered necessary for different branches of the Service are fixed by the Adjutant-General after consultation with the Director-General, Army Medical Services (represented by the Director of Hygiene), and with the Director of Recruiting and Organization.

In fixing these standards we have to be guided to a considerable extent by the conflicting factors of supply and demand, and since the War the supply of material of good physical quality has been so meagre that our

[1] A contribution to the Discussion on Physical Efficiency at the Royal Society of Medicine.

minimum standards have had to be reduced to an extent which interferes very considerably with the provision of an ideal fighting force.

The standards being fixed, they are then embodied in various regulations and instructions. The next step is to ensure that only officers and men of the required standards are admitted, and, to this end, the following procedure is adopted :—

(1) *Candidates for Commissions.*—These are examined by a Medical Board at the Central London Recruiting Depot, Whitehall, which is presided over by the Senior Medical Officer, Recruiting, a Lieutenant-Colonel, R.A.M.C., and consists of two specially trained medical officers on the depot staff, an eye specialist and a dental officer—any other specialist is co-opted when necessary. If a candidate is found unfit by this Board he may appeal. He is then examined by a special War Office Board, of which the D.G., A.M.S., is chairman, and on which are two well-known civilian doctors specializing in the particular disabilities for which the candidates have been rejected.

(2) *Recruits.*—These are first seen by paid Pensioner Recruiters and Recruiting Officers, who are not medical men, and they reject any who are obviously—even to the lay eye—not up to the physical standards required by the Army. Those who pass this preliminary test are then examined by officers of the R.A.M.C. or by civilian doctors specially employed by the Army on these duties.

All R.A.M.C. officers, while undergoing a course of study at the Royal Army Medical College, receive from the Senior Medical Officer, Recruiting, special instruction and training in the duties and pitfalls confronting a medical examiner of recruits. It might be thought that any doctor could examine a recruit efficiently. The fallacy of such a belief is evidenced by the expense incurred by the State through the subsequent rejection of recruits passed by men who have not been trained in this work.

Now a recruit who may be below the required standards in one respect, but who is otherwise specially desirable, may be put up as a special case for consideration by the Assistant Director of Hygiene of the Command or, in special cases, by the Director of Hygiene, War Office. If any one of these specialist hygiene officers agrees to accept such a recruit, he must not subsequently be discharged for the particular physical defect without approval of the Assistant Director of Hygiene of a Command or the Director of Hygiene, War Office.

The Hygiene Directorate, which includes all hygiene specialists specially employed in Districts, Commands, the Army School of Physical Training, and the Royal Army Medical College, is responsible for the medical aspect of recruiting. All officers of the Directorate, and also the Senior Medical Officer, Recruiting, and his staff, work under the technical control of the Director of Hygiene, War Office, who is the adviser of the Director-General, Army Medical Services, in all such matters.

Organization for Directing and Controlling Physical Training Instruction and for Assessing Physical Efficiency in the Army.

The Director of Military Training, War Office, is responsible for these duties and he has working directly under him at the War Office the Inspector of Physical Training assisted by a Staff Officer.

The Inspector of Physical Training makes an annual inspection of physical training in Districts and Commands.

Each Command Headquarters has an officer of the General Staff responsible for the physical training in the Command. He visits all units and depots in the Command about once a month to ensure uniformity and efficiency in the training and to note the progress made by those under instruction.

Each depot has an officer who has completed a physical training course at the Army Physical Training School, Aldershot, and he supervises the physical training of recruits at the depot and has under him a specially trained physical training instructor who is a member of the Army Physical Training Staff and is wholly employed on physical training duties. To assist him he has two physical training instructors not wholly employed on these duties but who have received one and a half months physical training in the Command and three months in the Physical Training School, Aldershot.

Physical training instructors of the Army Training Staff are picked from their units for a three months' course at the Physical Training School with N.C.O.'s from units.

Promising men from this course are recommended for an advanced course of six months to one year with their unit—mostly at depots—instructing recruits.

After this they have a three months' advanced course at the Army Physical Training School, Aldershot. As the result of this course about fifty per cent are taken on as probationers and are kept at the School for a further three months learning fencing and organization, and are then sent out to depots and units as required, usually to act for some time under a fully trained and experienced N.C.O. of the Army Physical Training Staff.

All physical training instructors are taught anatomy, physiology, remedial exercises and first aid by the Hygiene Specialist on the Staff of the Army School of Physical Training, Aldershot, for without a knowledge of the first three of these subjects they cannot be efficient instructors in physical training.

The Physical Training of R.A.M.C. Officers.

(*a*) All R.A.M.C. officers receive theoretical instruction in the physiology of physical exercises from the Professor of Hygiene, Royal Army Medical

College; they now also undergo a special course of training, lasting fourteen days, at the Army Physical Training School, Aldershot. At this course they are taught the aims and objects of physical training and of the different exercises in the Army physical training tables. They undergo actual physical training while at the depot at Crookham, Aldershot.

(*b*) All Hygiene Specialists also receive special instruction in physical training, including that given above.

This enables R.A.M.C. officers to supervise intelligently the medical aspects of physical training at depots and in units, and to recommend, when necessary, periods of rest or modified training for special cases, or remedial exercises for certain physical defects, e.g., flat feet, spinal curvature, etc.

(*c*) On the Staff of the Army School of Physical Training there is a Hygiene Specialist who has not only received the instruction just mentioned for officers of the R.A.M.C. and Hygiene Specialists, but who has also undergone a full physical training course at the Army Physical Training School, Aldershot, and has received special training in physiology and physiological investigations from Professor Cathcart, Department of Physiology, Glasgow University. This Hygiene Specialist supervises the whole of the physiological aspect of physical training at the Army Physical Training School.

(*d*) Finally, the Director of Hygiene, War Office, is responsible to the D.G., A.M.S., for the whole of the medical aspect of the physical training of the Army.

THE PHYSICAL TRAINING OF OFFICER CADETS, OFFICERS, RECRUITS AND SOLDIERS.

Officer Cadets.—Proceed either to the Royal Military Academy, Woolwich, or to the Royal Military College, Sandhurst, and while there undergo regular physical training instruction on the same lines as the recruit, up to Table VI of the recruits' tables.

Officers.—After passing out of these establishments and receiving their Commissions as officers, all lieutenants of Cavalry and Infantry have to undergo a special six weeks' course of physical training at the Army Physical Training School during the first two years of their service. This produces the most beneficial effects on the physical efficiency of these officers.

Recruits.—Every Infantry and Royal Tank Corps recruit, during his five to six months' stay at his depot, puts in ninety-five physical training attendances of one hour each; when doing physical exercises he wears special light clothing consisting of shorts, vest, socks and shoes. Cavalry recruits put in seventy attendances and other arms slightly fewer, according to the nature of their duties.

Soldiers.—After the recruit leaves his depot and joins his unit as a soldier he has about half an hour's physical training daily during the individual training season. The exercises are taken from the trained

soldiers' P.T. tables. In addition he joins in special physical training games—exclusive of the usual field games (football, hockey and cricket).

Boys.—Special tables are issued in the form of a table card for boys of all arms between the ages of 14 and 18 years.

These tables omit the exercises entailing strenuous muscular effort and concentrate on those requiring co-ordination and alertness instead of strength.

For boys under 14 the exercises are almost altogether of a free standing type and apparatus is sparingly used.

Physical Training Tables.

Our latest physical training tables are a mixture of the Swedish (Ling) and the Danish (Niels-Bukh) systems, grouped and arranged in a special order of our own.

How the Tables Attain Their Object.

Each table is a daily lesson—subdivided into groups as follows:—

I. *Introductory.*

To warm the body up to the physiological optimum temperature (100·5° F.). To ensure good carriage and true balance. The exercises are highly co-ordinated and stimulate nerve control and produce alertness.

II. *General.*

(1) Heaving exercises designed to develop strength, endurance, pluck, and determination to carry on as long as possible. There is little muscular effort, but good nerve control is needed, co-ordination being paramount. The exercises promote grace of carriage and overcome awkwardness and stiffness. As showing how they improve nerve control: a Depot Commander when he found his recruits were nervous of shooting put them on to practise balance exercises rather than on to extra musketry. The results he obtained were most satisfactory; a very marked improvement in the standard of musketry resulted.

(2) Abdominal and dorsal exercises. These promote correct carriage of body and proper action of the digestive organs: they also produce strength for the carriage of loads on the back.

(3) Agility exercises to promote co-ordination—nerve control, strength, agility, dash, pluck, determination. This group, which includes horse- and ground-work, brings out all qualities which have been promoted by the earlier groups.

(4) Final exercises. To cool the body off.

Objects of Physical Training.

They are: (1) To develop character; (2) produce alertness and virility of body and mind; and (3) create bodily and mental fitness in harmonious proportions.

Type of Raw Material.

Officer Cadets.—While most of these have a good framework, weighing on the average about ten stone, many are suffering from the lack of suitable physical training at school as evidenced by flat chests, poor chest girth and inability to expand their chests (over 51 per 1,000 are under the required standards for chest measurements), a slouching gait and carriage, postural defects such as spinal curvature, and poor development of the upper part of the trunk. Approximately 120 per 1,000 of those applying for commissions fail in some physical respect to reach the required Army standards, which are not high, and a good many border-line cases are accepted.

Recruits.—Eighty-two per cent are from industrial areas; our present minimum standards of height and weight are low, being respectively 62 inches and 115 pounds, with a 33-inch fully-expanded chest. In consequence, the physical standard of many recruits on joining is poor and they show evidence of being underfed and underdeveloped. Approximately 523 per 1,000 of those offering themselves for enlistment were rejected for medical and physical reasons in 1931.

Requirements of a Trained Soldier.

What are we trying to produce?

"A soldier who is well disciplined, a good marcher, intelligent, smart, active and quick, able to surmount obstacles in the field and capable of withstanding all the strains and hardships of active service."

Assessment of Physical Fitness.

Officer Cadets.—On entering the Royal Military Academy, Woolwich, or Royal Military College, Sandhurst, each cadet has his physical efficiency assessed. Sandhurst Cadets have their physical efficiency again assessed at the end of one year when they have to pass an examination in physical training. At Woolwich the second assessment is made and the examination held at the end of eighteen months.

These officer cadets are also weighed on joining, at the end of their course of physical training, and at regular monthly or two-monthly periods during the course.

Recruits have their physical efficiency assessed on joining their depots, again when about half way through their depot training, and a final assessment is made on the completion of their depot training. Their weight is taken and recorded monthly.

Physical fitness is assessed by noting:—

Development of Character.—This is assessed by: (1) Testing leadership. This is proved by tests in giving words of command, arrangement of apparatus, method of handling a class, explanation and illustration of exercises, detection and correction of errors, the use of tables, etc. Those being tested are, in turn, given charge of a squad after six weeks at the physical

training course. (2) General conduct. (3) Pride in personal appearance. (4) Attendance at voluntary periods of physical training. (5) Alertness of mind and body. (6) General smartness. (7) Reaction times, auditory and visual. (8) Co-ordination. This is tested by means of a series of targets arranged irregularly but in a definite sequence. A metronome is set to beat 160 times to the minute and the person being tested endeavours to score bulls on the targets in their proper sequence and in time with the beats of the metronome. Marks are allotted according to the number of bulls, inners or outers scored; according to the number of marks scored so is his co-ordination assessed and recorded as a percentage. This has proved to be a very valuable test. (9) Readiness to assimilate education. Over forty per cent of infantry recruits on joining the Army are very badly educated; some 30·02 per cent of these infantry recruits can only read a very elementary book, write to dictation easy words in common use, and work out the four rules in arithmetic. 10·52 per cent fail to reach even that standard, i.e., they are illiterate.

In 1930, 30·9 per cent of all recruits were in one or other of these very low categories as regards education, although education is compulsory up to the age of 14 in this country. Now, after the few months physical and mental education at the depot, from 90 to 100 per cent of these recruits obtain an Army 3rd class certificate of education which is the equivalent of the 3rd or 4th standard in a primary school. Quite a fair percentage take an Army 2nd class certificate while still at the depot. At one depot recently 100 per cent took a 2nd class certificate which is the equivalent of the 6th standard in a primary school. The 2nd class certificate standard is not normally aimed at in the depot education—this and the 1st class being delayed till after the recruit joins his unit, when quite a high percentage take both classes.

Harmony of Mental and Bodily Fitness.—This is tested by (1) Physical efficiency field tests and physical training tests (see later). (2) Weight. This increases, unless the man is obese when there is a primary loss followed by a gain as his muscular tone improves. (3) Pulse-rate. This decreases as result of physical training when he gains in physical efficiency. Readings are taken: (i) at rest; (ii) immediately after standard exercise; (iii) one minute after the standard exercise. The pulse is taken for a quarter of a minute in each of these tests. The standard exercise consists of three pulls up on the horizontal bar—the pulse being taken on coming down at the end of the third pull. (4) Strength. Grip, as measured by a dynamometer, improves. (5) Reaction times, auditory and visual; these improve. (6) Co-ordination; improves.

There have been no cases of disordered action of the heart at the Army School of Physical Training since the introduction of the present system of physical training. Before the introduction of the Swedish (Ling) method, i.e., prior to 1908-1912, disordered action of the heart as the direct result of unsuitable physical training was common.

Physical Efficiency Field Tests.—These consist of tests in the following events : 100 yards, high jump, running long jump, putting or heaving shot, 1 mile, 2 mile, 3 mile. According to efficiency of performance marks are allotted up to 100 per cent. The physical efficiency classification then is 50 per cent = standard ; 60 per cent = 2nd class ; 74 per cent = 1st class ; 84 per cent and over = special.

SCALE OF MARKING.

Marks	1 100 yards Seconds	2 High jump Ft.	 in.	3 Running long jump Ft.	 in.	4 Putting or heaving shot Feet	5 1 Mile Min.	 Sec.	6 2 Mile Min.	 Sec.	7 3 Mile Min.	 Sec.
10	$11\frac{3}{5}$	5	0	18	0	32	5	0	10	30	16	30
9	$11\frac{4}{5}$	4	8	17	0	29	5	15	10	45	17	0
8	12	4	6	16	0	26	5	30	11	0	18	0
7	$12\frac{3}{5}$	4	4	15	0	24	5	45	11	40	19	0
6	13	4	2	14	0	22	6	0	12	30	21	0
5	$13\frac{2}{5}$	4	0	13	6	20	6	20	13	30	23	0
4	$14\frac{1}{5}$	3	10	13	0	18	6	30	15	0	26	0
3	$14\frac{3}{5}$	3	8	12	0	16	6	50	16	50	29	0
2	15	3	6	11	0	14	7	20	18	30	32	0
1	16	3	4	10	0	12	8	0	20	0	35	0

Physical Efficiency Classification will be found by multiplying by 2 the aggregate of the 5 tests completed.

Recruits on joining—Tests 1 to 5.	Special	.. .. ..	84	per cent
,, Intermediate ,, 1 to 4 and 6.	1st Class	.. ..	74	,,
,, Final ,, 1 to 4 and 7.	2nd Class	.. ..	60	,,
	Standard	.. ..	50	..

Physical efficiency field tests of recruits are carried out at all depots which have an instructor of the Physical Training Staff. Each recruit on joining is tested in events 1 to 5, but 1 mile is not run until the recruit has had one month's training. An intermediate test is made in events 1 to 4 and 6. A final test is made at the end of sixteen to eighteen weeks' depot training in events 1 to 4 and 7. The recruits are also weighed monthly and the results of the tests and the weighing are recorded on the physical efficiency and weight chart, which is hung up in the gymnasium to stimulate the interest of the recruits in their physical condition. The average increase in weight of recruits at the termination of their depot training is eight pounds—some show a much greater increase, some a rather smaller increase.

The final classification of recruits is recorded on A.F. 266 for the information of the Officers Commanding units to which the recruits are posted. This is a great assistance to commanding officers in selecting suitable men for certain duties.

The Inspector of Physical Training also gets a half yearly return of field tests.

In addition to the physical efficiency field tests which we have just considered, the physical fitness of recruits, trained soldiers, assistant

instructors and assistant physical training staff instructors is also assessed by means of physical training tests, which are divided into five categories :—

(1) Climbing (rope); (2) heaving; (3) balance; (4) horse-work; and (5) ground-work. Proficiency in these is graded as standard, 2nd class, 1st class, and special, as in the field tests.

Special assessments or investigations in regard to special aspects of physical efficiency are made from time to time at the Army Physical Training School by the Hygiene Specialist, to test:—

The Correlation Between Vital Capacity and Endurance.—Tests were made with good and with inferior cross-country runners, and the results seemed to indicate that there was a correlation between powers of endurance and vital capacity.

Effects of Smoking on: (*a*) Endurance; (*b*) short bursts of energy, e.g., sprinting.

The influence of smoking on endurance was tested by the effect of a three mile run on 2,053 men with the following results: In the first ten places 5·8 per cent were heavy smokers, 8·8 per cent moderate smokers, 18·2 per cent. non-smokers. In last ten places 11·6 per cent were heavy smokers, 11·5 per cent. moderate smokers, 4·1 per cent non-smokers.

The effects of smoking on short bursts of energy were tested on sprints with 285 men. In the first ten places 20·8 per cent were heavy smokers, 8·3 per cent moderate smokers, 13·8 per cent non-smokers. In the last ten places 16·5 per cent were heavy smokers, 9·3 per cent moderate smokers, 12·0 per cent non-smokers.

Energy Expenditure in the Various Exercises of Recruits.—This investigation was made by the Douglas-Haldane method to test *the soundness of the grouping of the present exercises and of the progression throughout the tables.* The results on the whole confirm the soundness of both—only minor alterations are indicated.

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QUININE PROPHYLAXIS IN NORTHERN INDIA.

By Major T. YOUNG,

Royal Army Medical Corps.

(*Continued from p.* 267.)

In 1929 a total of 701 British and 3,560 Indian troops at Nowshera, Peshawar, Shagai and Landi Kotal in the Peshawar district, and Hangu and Thal in the Kohat district, were included in the test, which extended from September 1 to December 4—over three months. During this time quinine was only given for two periods each of three weeks. There was an interval of ten days between these periods. The last six weeks of the experiment served for observing whether any "suppression" of malaria had taken place as a result of the administration of quinine.

The procedure adopted was similar to that already described, with minor local modifications. In certain Indian units the quinine mixture was poured out of a gallipot into the open mouths of the sepoys as they squatted on the ground in rows, and in most stations, magnesium sulphate was added in the preparation of the quinine mixture already described.

The quinine group was numerically between two and three times the size of the control group.

Observation was kept to see whether the finding of parasites was more difficult in blood films from cases admitted from the quinine group, and whether the cure of the disease (as evidenced by the duration of stay in hospital) was delayed.

The effect of the experiment on two groups of soldiers was also watched. One group was composed of young soldiers fresh from the United Kingdom and not previously exposed to malarial infection, and the other of slightly older men who had spent one or more seasons in India and many of whom had suffered from malaria.

With a view to forestalling the suggestions (provided that the results turned out to be satisfactory) that quinine might simply have confused the diagnosis and caused malaria to be returned as some other disease, or that some enthusiastic protagonist of quinine prophylaxis might have assisted the production of good results by unconsciously misdiagnosing cases of malaria in the quinine groups, it was decided in all cases to record: "Total Admissions from All Causes" from both groups. Numbers of admissions from causes other than malaria could, therefore, be closely scrutinized and any material difference in the two groups investigated.

It should be clearly understood that during the whole period covered by the experiment, viz., four years, there was, of course, not the slightest relaxation in the other anti-malaria measures at our disposal which were everywhere prosecuted with the customary vigour and method.

Early in 1930 arrangements were made and details worked out for a final test covering all troops, British and Indian, in the two areas. It was thought that 30,000 men would be involved in the experiment and as events turned out this number would have been greatly exceeded. It was proposed to endeavour to determine, among other points, an optimum dosage and whether or not an interval between courses was really necessary or even advisable.

However, the experiment was forbidden by "higher authority" on the grounds that the case for quinine prophylaxis had been completely proved, and orders were received to issue 10 grains of quinine (acid solution) daily, five days a week, for a period of ten weeks, from the beginning of September to the middle of November to all troops in malarious stations. This was done and a questionnaire was submitted to all hospitals asking for information on the following points:—

(*a*) Opinions of Commanding and other officers and medical officers as to the efficacy of quinine prophylaxis as practised.

(*b*) Popularity with the men.

(*c*) Any defects noted in the method of administration, e.g., dose, time, frequency, duration, etc.

(*d*) Percentage of fever cases to total admissions during the period buinine has been administered this year and the two previous years.

(*e*) Proportion of benign tertian to malignant tertian cases during the period under review and during the corresponding period in previous years.

(*f*) Any evidence of quinine-fast parasites.

(*g*) Any evidence that quinine prophylaxis renders the recognition of malaria parasites in the blood stream more difficult.

(*h*) Any evidence that quinine prophylaxis "masks" malaria or that the cessation of quinine is followed by an outbreak of these "suppressed" cases (say within a month of the cessation of the course).

With a view to the further reduction of malaria in the districts, quinine was given daily for ten days to all arrivals in healthy stations from malarious stations.

In addition, all troops on the line of march were given quinine, and this was continued for ten days after the termination of the march.

Results.

1926 (*vide Table I*).

Out of 210 troops who received quinine for three weeks from October 4 to 24 there were 17 cases of malaria during the whole of the month, corresponding to a ratio per thousand of 80·95. During the same period 68 cases occurred in the control group, 225 strong, representing a ratio per thousand of 302·22. The incidence of malaria, therefore, in the control group was almost four times that in the quinine group.

The numbers are too small to allow of a detailed analysis, but it would appear that the third unit shown (an R.A. Unit) did not re-act to the

treatment as well as the other units and that the infantry unit's response was considerably above the average. The interest shown by this infantry unit's Commanding Officer and the personal supervision given by him may afford the explanation of the difference.

TABLE I.—RESULTS OF QUININE PROPHYLAXIS, 1926.

Unit	Barrack room No.	Average strength during October	No. who received prophylactic quinine 4.10.26 to 24.10.26	No. who received no prophylactic quinine	Malaria admissions during October: No. who received prophylactic quinine	Malaria admissions during October: No. who received no prophylactic quinine	Malaria admissions during November: No. who received prophylactic quinine	Malaria admissions during November: No. who received no prophylactic quinine
— — Field Bty. R.A.	15, 16	114	50	64	5 (*a*)	21	7	4
— — Field Bty. R.A.	1, 2	109	56	53	2	12	14	11
— — Field Bty. R.A.	11, 12	100	39	61	7 (*b*)	16	7	14
— — F.A.C., R.A. ..	19	40	26	14	1 (*c*)	3	—	1
— — "A" Coy., Highlanders	6, 7, 8	72	39	33	2 (*d*)	16	6	6
Total		435	210	225	17 (80·95 ‰)	68 (302·22 ‰)	34 (161·9 ‰)	36 (160 ‰)

Note.—(*a*) One of these cases was admitted after the completion of the three weeks' course.
(*b*) Four of these cases were admitted after the completion of the three weeks' course.
(*c*) This case was admitted after the completion of the course (in this instance the course only lasted seven days as the unit moved to Akora Training Camp).
(*d*) One case was admitted on the second day of the course and the other a week after completion of the course.

It will also be noted that of the total of seventeen cases from the quinine group six occurred in the week immediately following the termination of the quinine course. This suggests a temporary suppression of malaria during the exhibition of the quinine. That such suppression, if it did occur, was of no material significance is evidenced by the fact that during the following month, i.e., November, the incidence of malaria in the two groups was practically identical, viz., 161·9 per mille in the quinine group and 160 per mille in the control group.

The value of carrying out the acid Tanret test on admission to hospital was nil, for it was practically always negative, many hours usually having elapsed since the last dose of quinine.

During 1927 I was present in the station during the whole period of the experiment, and was therefore in a position to give direct personal supervision and to carry out the statistical and other work involved.

1927 (*vide Tables II, III and IV*).

Quinine was given during September from the 5th to the 25th inclusive and during October from the 6th to the 26th inclusive to 194 British troops and 443 Indian.

TABLE II.—RESULTS OF QUININE PROPHYLAXIS. BRITISH UNITS, 1927.

Unit	Average strength September	Average strength October	No. who received prophylactic quinine Sept. 5 to 25 and Oct. 6 to 26	No. of controls Sept./Oct.	Malaria admissions during September						Malaria admissions during October					
					Recipients of prophylactic quinine		Control		Total cases in Unit		Recipients of prophylactic quinine		Control		Total cases in Unit	
					Actual Nos.	Incidence per 1,000	Actual Nos.	Incidence per 1,000	Actual Nos.	Incidence per 1,000	Actual Nos.	Incidence per 1,000	Actual Nos.	Incidence per 1,000	Actual Nos.	Incidence per 1,000
— Fd. Bty. R.A.	103	131	40	63/91	1 (a)		6		7		—		9		9	
— Fd. Bty. R.A.	101	134	41	60/93	1 (b)		8		9		—		10		10	
— Fd. Bty. R.A.	114	132	54	60/78	3 (c)		7		10		1 (e)		10		11	
— Bde. F.A.C. ..	40	43	15	25/28	—		1		1		1 (f)		2		3	
"B" Coy. 2nd Bn. — — Fusiliers	106	107	44	62/[illegible]	1 (d)		4		5		1 (g)		6		7	
	464	547	194	270/353	6	30·93 ‰	26	96·29 ‰	32	68·96 ‰	3	15·46 ‰	37	104·81 ‰	40	73·13 ‰

(a) One case admitted hospital on 1st day of 1st course
(b) ,, ,, ,, 2nd ,, ,, ,,
(c) ,, ,, ,, 3rd ,, ,, ,,
(—) ,, ,, ,, 6th ,, ,, ,,
(—) ,, ,, ,, 8th ,, ,, ,,
(d) ,, ,, ,, 3rd ,, ,, ,,
(e) ,, ,, ,, 3rd ,, 2nd ,,
(f) ,, ,, ,, 8th ,, ,, ,,
(g) ,, ,, ,, 12th ,, ,, ,,

TABLE III.—RESULTS OF QUININE PROPHYLAXIS (INDIAN UNITS), 1927.

Unit	Average strength September	Average strength October	No. who received prophylactic quinine Sept. 5 to 25 and Oct. 6 to 26	No. of controls	Malaria admissions during September						Malaria admissions during October					
					Recipients of prophylactic quinine		Control		Total cases in Unit		Recipients of prophylactic quinine		Control		Total cases in Unit	
					Actual Nos.	Incidence per 1,000	Actual Nos.	Incidence per 1,000	Actual Nos.	Incidence per 1,000	Actual Nos.	Incidence per 1,000	Actual Nos.	Incidence per 1,000	Actual Nos.	Incidence per 1,000
—/— Punjab Regt.	395	416	99	98	—	—	—	—	13	—	—	—	1	—	12	—
—/— Punjab Regt.	456	513	116	120	—	—	2	—	5	—	—	—	1	—	2	—
—/— Sikh Regt. ..	862	675	98	98	—	--	1	—	24	—	—	—	1	—	12	—
—/— Sikh Prs. ..	489	508	80	87	—	—	—	—	—	—	—	—	1	—	1	—
—/— I.B.T. Coy...	304	303	50	38	—	—	1	—	3	—	—	—	1	—	1	—
Totals	2,506	2,415	443	441	—	—	4	9·07 ‰	45	17·96 ‰	—	—	5	11·34 ‰	28	10·71 ‰

British.—During the whole of September the malaria admissions from the quinine group numbered 6, representing a ratio of 30·93 per mille, and there were 26 admissions from the 270 controls, a ratio of 96·29 per mille. During October there were 3 admissions from the quinine group (15·46 per mille) and 37 cases of malaria among 353 controls (104·81 per mille).

Indian Troops.—No cases of malaria occurred during September or October among the 443 Indian troops who received the quinine course. Among the 441 constituting the controls there were 4 cases (9·07 per mille) during September and 5 cases (11·34 per mille) during October.

While, therefore, no cases of malaria were recorded during the course of the experiment in the quinine group of Indian troops. Among British troops the incidence in September in the control group was over three times and in October nearly seven times that of the quinine group.

Examining the detailed figures by units it is seen that the R.A. units show better results in comparison with the infantry unit than was the case in 1926.

The question of suppression could not be investigated owing to the intervention in late October and November of training camps and manœuvres.

During August and September of 1928 I was absent from the station carrying on research work for a brother officer who was ill, and so the experiment was supervised in September by another officer. The scheme was, however, organized by me, was under my direct control in October, and the figures and results were collected and worked out by me.

1928 (*Table IV*).

At Nowshera quinine was given to 371 British and 1,142 Indian troops from September 24 to October 13, and again after an interval of ten days, from October 24 to October 31, when owing to training, etc., the experiment was terminated. But owing to the low incidence of malaria, the test was of very little value.

Two cases of malaria (5·39 per mille) occurred among the 371 quinine group (British groups) during the last week of September as against 2 (7·66 per mille) among the control group of 261. During October there were again 2 cases in the quinine group against 9 (31·14 per mille) among the control group of 289.

As regards the Indian troops there were no cases in either the quinine or control groups during the first part of the experiment. During October there were 6 cases in the quinine group of 1,142 representing a ratio per thousand of 5·26, and 11 cases in the controls 1,018 strong—a ratio of 10·81 per thousand.

Quinine was also given during the Chitral reliefs. On the outward journey 469 Indian troops received a dose for six to eight days, depending

TABLE IV.—SUMMARY OF RESULTS OF QUININE PROPHYLAXIS EXPERIMENT IN NORTHERN INDIA, 1926 TO 1929.

		Received Prophylactic Quinine.		Received *no* Prophylactic Quinine.			
Place	Period of experiment	No. receiving quinine with dates	* No. of cases of malaria (incidence per ‰ in brackets)	No. receiving no quinine	* No. of cases of malaria (incidence per ‰ in brackets)	Estimated saving of malaria admissions among quinine roll. (Estimate based on rate prevailing among controls)	Total numbers under experiment
			British Troops.				
Nowshera ..	Oct., 1926 ..	210 (4.10.26 to 24.10.26)	17 (80·95 ‰)	225	68 (302·22 ‰)	47	435
	Nov., 1926		34 (161·90 ‰)	—	36 (160·00 ‰)	—	—
do.	Sept., 1927 ..	194 (5.9.27 to 25.9.27)	6 (30·93 ‰)	270	26 (96·29 ‰)	13	464
	Oct., 1927 ..	194 (6.10.27 to 26.10.27)	3 (15·46 ‰)	353	37 (104·81 ‰)	17	547
do.	Sept. 24 to 30, 1928	371 (24.9.28 to 30.9.28)	2 (5·39 ‰)	261	2 (7·66 ‰)	1	632
	Oct., 1928 ..	371 (1.10.28 to 13.10.28 & 24.10.28 to 31.10.28)	2 (5·39 ‰)	289	9 (31·14 ‰)	10	660
Nowshera and Peshawar	Sept. 1, 1929 to Dec. 4, 1929	473 (1.9.29 to 21.9.29 & 2.10.29 to 22.10.29)	228 (482·03 ‰)	228	145 (635·96 ‰)	73	701
			Indian Troops.				
Nowshera ..	Sept., 1927 ..	443 (5.9.27 to 25.9.27)	—	441	4 (9·07 ‰)	4	884
	Oct., 1927 ..	443 (6.10.27 to 26.10.27)	—	441	5 (11·34 ‰)	5	884
do.	Sept. 24 to 30, 1928	1,142 (24.9.28 to 30.9.28)	—	953	—	—	2,095
	Oct., 1928 ..	1,142 (1.10.28 to 13.10.28 & 24.10.28 to 31.10.28)	6 (5·26 ‰)	1,018	11 (10·81 ‰)	6	2,160
Chitral Relief Column	Outward journey, Sept., 1928	469 (6 to 8 days)	3 (6·39 ‰)	3,202	57 (17·80 ‰)	5	3,671
	Homeward journey, Oct., 1928	538 (6 to 8 days)	—	3,046	26 (8·53 ‰)	5	3,584
Nowshera, Peshawar, Shagai, Thal, Hangu, Landi Kotal	Sept. 1, 1929 to Dec. 4, 1929	2,455 (1.9.29 to 21.9.29 & 2.10.29 to 22.10.29)	854 (347·86 ‰)	1,105	591 (534·84 ‰)	459	3,560

* These totals include all cases of malaria admitted, not merely during the period when quinine was being given, but during the whole period of experiment (*vide* column 2).

on the date of their arrival at Dargai, and 538 received a dose on the homeward journey for six to eight days depending on the date of their departure from Dargai.

The evidence, so far as Nowshera is concerned, slender though it is, is quite decidedly in favour of quinine prophylaxis.

The figures for the Chitral Relief Column are, however, more convincing, and moreover it should be borne in mind that quinine was only given for a relatively short period of the whole march. On the outward journey the quinine roll of 469 had only 3 cases of malaria (incidence ratio per mille 6·39) whereas the control of 3,202 had 57 cases (incidence ratio per mille 17·80) i.e., the controls had nearly three times as much sickness due to malaria. On the homeward journey the 538 who were on quinine had no malaria. The control, 3,046 strong, had 26 cases representing a ratio of 8·53 per thousand.

During 1928 the experiment was under my administrative control only. Detailed instructions were issued on my initiative, and the working out of the scheme was left to medical officers on the spot.

1929 (*vide Tables IV, V and VI*).

In 1929 the scope of the experiment was greatly extended and included 701 British and 3,560 Indian troops in six different stations in Peshawar and Kohat Districts.

The experiment lasted for 95 days though quinine was only given for two periods of three weeks, viz., from September 1, 1929, to September 21, 1929, and again, after a ten-day interval, from October 2, 1929, to October 22, 1929. The test was thus divided into four distinct parts, viz. :—

(1) First quinine course of twenty-one days (with one day's rest per week).

(2) Interval of ten days.

(3) Second quinine course of twenty-one days (with one day's rest per week).

(4) Observation period of six weeks.

The detail of results is given by units and in the case of all important totals the ratio per mille has been worked out to aid comparison. Further, to facilitate comparison of the relative incidence in the different periods as indicated above the equivalent annual ratios of admissions for malaria and admissions from all causes during each period have been added at the bottom of Table V and Table VI for quinine and control rolls. In addition the last column of each of the tables referred to shows the estimated saving of admissions for malaria. This estimate is based on the malaria rate prevailing among the controls.

Following two good years, 1928 being a record good year, 1929 proved to be the worst year on record in the district for malaria.

Out of a total of 473 British troops on the quinine roll 228 contracted malaria during the whole period of 95 days, giving a ratio per mille of

TABLE V.—RESULTS OF QUININE PROPHYLAXIS EXPERIMENT. BRITISH TROOPS—ADMISSIONS FROM QUININE ROLL.

Station and Unit	Strength	1st Course		Interval		2nd Course		Next 6 weeks		TOTAL	
		Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total
PESHAWAR.											
— (M) Bty. R.A.	30	—	4	2	3	3	4	8	10	13	21
— Fd. Bty. R.A.	36	—	5	2	3	2	3	6	10	10	21
Total Peshawar	66	—	9	4	6	5	7	14	20	23	42
Ratio per mille Peshawar		*Nil*		60·6		75·76		212·12		348·48	636·36
NOWSHERA.											
"B" Coy. 2nd — —	130	1	2	5	8	20	23	50	59	76	92
Dett. Distt. Sig.	13	—	—	—	—	—	1	—	—	—	1
— Fd. Bty. R.A.	93	—	4	4	5	16	19	32	41	52	69
— Fd. Bty. R.A.	82	—	—	2	3	15	17	21	29	38	49
— Fd. Bty. R.A.	72	—	—	2	4	9	13	22	26	33	13
— Fd. Bde. F.A.C.R.A.	17	—	—	—	—	2	2	4	4	6	6
Total Nowshera	407	1	6	13	20	62	75	129	159	205	260
Ratio per mille Nowshera		2·46		31·94		152·34		316·95		503·69	638·82
Total Peshawar and Nowshera	473	1	15	17	26	67	82	143	179	228	302
Ratio per mille Peshawar and Nowshera		2·11	31·71	35·94	54·97	141·65	173·36	302·38	378·44	482·03	638·48
Equivalent annual ratio per mille		36·7	551·1	1311·8	2006·3	2461·9	3013·2	2627·4	3288·8	18·17	2479·1

* N.B.—This is the sum of the estimated savings of each unit and does not agree with

482·03. During the same period there were 145 cases of malaria among 228 controls—a ratio per mille of 635·96. The difference in favour of the quinine roll is 153·93 per mille. It is estimated that if the rate prevailing among the controls had prevailed among the quinine roll, i.e., if no quinine had been given, 85 more cases of malaria would have occurred. That is to say, there has been an estimated saving of 85 cases of malaria, calculated by units, or 27 per cent of the estimated total.

The total of admissions from all causes on the quinine roll was 302 (ratio per mille 638·48) and on the control roll 178 (ratio per mille 780·70), the admission ratio for all causes other than malaria being therefore 156·45 per mille in the case of the quinine roll and 144·64 per mille in the controls. It is evident, therefore, that no great "masking" occurred and that mis-

PESHAWAR DISTRICT. SEPTEMBER, OCTOBER AND NOVEMBER, 1929.

ADMISSIONS FROM CONTROL ROLL.

Strength	1st Course		Interval		2nd Course		Next 6 weeks		TOTAL		Estimated saving of malaria admissions among quinine roll. (Estimate based on rate prevailing among controls)	
	Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total	Nos.	Percentage
30	1	2	3	3	4	4	1	3	9	12	− 4	44%
31	2	6	3	4	11	11	7	9	23	30	+ 17	63%
61	3 49·18	8	6 98·36	7	15 245·90	15	8 131·15	12	32 524·59	42 688·52		
50	1	2	6	6	10	12	31	36	48	56	+ 49	39%
5	—	—	—	—	1	1	1	1	2	2	+ 5	100%
40	1	1	2	2	10	10	11	12	24	25	+ 4	7%
32	1	7	2	3	6	7	7	9	16	26	+ 3	7%
35	3	4	3	3	5	5	10	13	21	25	+ 10	23%
5	—	—	—	—	1	1	1	1	2	2	+ 1	14%
167	6 35·93	14	13 77·84	14	33 197·61	36	61 365·27	72	113 676·65	136 814·37		
228	9	22	19	21	48	51	69	84	145	178	*+ 85	27%
	39·47	96·49	83·33	92·10	210·53	223·69	302·63	368·42	635·96	780·70		
	686·0	1677·1	3041·6	3361·8	3659·1	3887·8	2630·0	3201·7	2469·4	3031·4		

the estimated saving worked out on the total incidence of malaria for the whole area.

diagnosis of malaria for other causes was at all events uncommon. There was a genuine reduction in the sick rate and it seems only reasonable to attribute this reduction to the quinine prophylaxis.

(To be continued.)

THE MODERN DIAGNOSIS AND TREATMENT OF SYPHILIS.[1]

By Major L. B. CLARKE,
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Syphilis has been chosen as the subject of this evening's lecture for several reasons: it is the most interesting disease which the dermatologist has to discuss, it is the most important with which he has to deal, and its errors of diagnosis, particularly those of omission, are so serious that they may confound the doctor and condemn the patient.

Universal in its incidence, it is no respecter of persons. It may attack both sexes and all ages. Neither the old nor the young is exempt, and it may even kill the unborn child.

Throughout the ages syphilis has pursued its devastating course, unhampered and unchecked, and it has baffled the best brains of the civilized world for more than four out of the four and a half centuries of its known existence. Even now with the "much" we know there is the "more" to be learnt.

Equally wide with its geographical distribution are its curious habits of trespassing into the domain of other subjects. It is the arch poacher of the various specialities. It crops up, unannounced and unwelcomed, in the realms of medicine, surgery, midwifery and gynæcology, and most of the other specialist subjects.

It is therefore not overstating the case to say that in many respects syphilis is different from most of the other diseases with which our profession has to deal.

Not only is it a different disease, but it is also a very treacherous disease. It is treacherous because:—

(1) The patient with syphilis is usually quite fit and does not feel ill. He does not therefore consult a doctor, at any rate in the early and contagious stages.

(2) It is treacherous because there is practically no pain. Nearly all its manifestations are quite painless. After all, what is pain? It is Nature's danger signal which tells us that something is wrong. It is the red lamp on the railway warning us of the danger ahead. In nearly all other diseases this danger signal operates and the patient consults his doctor. In syphilis Nature does not help but lets us down.

(3) It is also treacherous because of its imitative faculty; it may imitate almost any disease under the sun. The primary sore may resemble soft

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[1] Lecture given before the Medical and Dental Officers of the Aldershot Command in the Cambridge Hospital, Aldershot, on February 27, 1933.

chancre, the secondary rashes many of the skin diseases and the exanthemata, and in the tertiary stage the gummata many varieties of tumour. To add to our confusion it may, in the tertiary stage, even imitate itself in the primary stage, in the form of a chancriform gumma.

(4) It is further treacherous, because once the disease has apparently finished it may leave in its wake two other conditions, tabes and general paralysis of the insane, both of which have until recently been always regarded as fatal.

Robert McKenna, in his "Diseases of the Skin," gives the best summary I have seen. He says, "The disease may affect all the organs and tissues of the body, and may declare itself by recurrences or reminders over a long period of years. One of the three chief killing diseases, syphilis is the great simulator and the great deceiver. Its cutaneous manifestations may closely resemble perfectly innocent affections of the skin; and its long periods of quiescence, during which there is no outward evidence of the plague within the body, give to the sufferer an unwarranted sense of security, deceiving him into the belief that he is cured, the while the spironema, at work in some vital organ like the brain, is compassing his premature death."

Such a disease, with its curious characteristics, is therefore worthy of our closest study.

It is not my intention to inflict on a medical audience a detailed discussion of facts with which they are familiar, so I propose to consider only the important signs and symptoms which have a bearing on the differential diagnosis and then to discuss the treatment. It can in no way be a complete survey.

The Incubation Period and the Course of the Disease.

First let us consider the incubation period and then the course of the disease. The older textbooks gave the incubation period as eighteen to twenty-five days with an average of twenty-one. This may hold good for many cases at the present time, but one must recognize that in quite a large number of cases the incubation may be thirty days, in others still longer. During the last year two cases were admitted to the Connaught Hospital from India where the incubation period was fifty-six and sixty-four days respectively.

Here, however, a word of warning should be uttered, for it is often a matter of difficulty to obtain an accurate history from our patients; they may be careless, stupid, or intentionally dishonest, and it is not too much to say that all venereal cases should be regarded as potential liars. Again, a recent exposure may be quite frankly admitted, but modesty may prevent the disclosure of multiple exposures. The chief moral to draw is of course never to place reliance on a negative history.

Well, we will assume that our case was exposed to infection twenty-one days previously. He reports sick with a sore on the penis and the primary

stage comes under review. Here we may meet our first snag. He may have done one of two things, perhaps in perfectly good faith, which may hamper us in dealing with the case. Firstly, he may have delayed reporting for several days because the sore was painless; it did not hurt him so he did not bother about it. Or, secondly, he tried to treat it himself with some antiseptic, thereby killing the spironemes, and so invalidating the use of the dark-ground microscope.

The correct procedure of course is for him to report at once. Failure to report sick with venereal disease is included in failure to comply with Standing Orders and is covered by Section XI of the Army Act. If a case cannot be dealt with at once it should be treated by saline dressings and in no other way.

The sore then constitutes our first cardinal sign. It may be on the glans, the coronal sulcus, the shaft of the penis, the pubic region or in some extra-genital area. The commonest of extra-genital are the lips, the tongue, the throat, the fingers, the breast and the eye. A slowly healing ulcer, especially if it be painless in any of these places, should always be suspect. Whitlows on the fingers have been frequently found to be syphilitic. Doctors, nurses and orderlies are the most likely people to have these and great care should always be exercised.

Again, a common occurrence in certain parts of the country, viz., the mining districts, is a chancre of the eye. A miner gets a bit of coal grit into his eye, his friend comes along with a saliva-moistened handkerchief, removes the grit and successfully inoculates the spironemes into the abraded area of the cornea. Such cases in these districts were at one time as common as they were tragic.

To return to the typical case. The sore develops slowly and surely and gradually becomes harder. This quality of hardness has always been held to limit the disease for the time being to the actual sore, the fibrous tissue of the sore acting as a rampart to protect the body from invasion by the spironemes. That this is so is nowadays rather doubted, for the organisms have been recovered from the nearest lymph-glands in the rabbit within half an hour of their inoculation, and in the guinea-pig within five minutes [1].

The inguinal glands next take upon themselves the defence of the body and enlarge to form the typical shotty glands. These are painless and hard. If they did their work efficiently they would limit the disease to the genitals and syphilis would be a comparatively simple and safe disease. Unfortunately they do not. They allow the organisms to leak through, invade the body generally and so lead up in a period of approximately six weeks to the secondary stage.

Now, what is happening during this interval? We have always been taught that the inguinal glands are the main defence of the body and that for six weeks at any rate the disease is held in check; that no spironemes can leak through and our patient is safe. Again, another of our preconceived ideas has to vanish in the light of fuller knowledge.

Many people consider that very early after the commencement of the sore the condition becomes generalized, and this is borne out by certain tests on the cerebrospinal fluid which show within a few days of the appearance of the primary sore the same results as are seen years afterwards in tabes.

One moral at any rate is pointed by this, and that is the absolute necessity for immediate diagnosis and treatment. I consider that syphilis ranks with appendicitis and malaria as a disease which must be dealt with at once.

The secondary stage comes on at about six weeks and one of the many types of rash will then commence. They are first seen on the upper part of the chest; they spread downwards, involve the abdomen, the back and the limbs. The distribution is nearly always symmetrical. Starting as macules, they become papules and much later on pustules. The epitrochlear, the axillary, and the cervical glands enlarge, the throat becomes congested, and ulcers appear on the fauces, the soft palate and the tongue. The temperature rises very frequently and finally condylomata occur around the anus. This, then, is the course of the secondary stage in a typical case. Less commonly iritis may occur.

The classification into secondary and tertiary stages is rather vague, but at a period of anything from a few months to a few years the tertiary stage commences. It should be regarded as a process of merging, of contraction from a generalized to a localized condition. The rash recedes, becomes rounded, forms part of a circle, and finally contracts down to a gumma of the skin.

Within the body the generalized condition also becomes localized; gummata may form in any part of the body, the heart is frequently involved, aneurysm may develop, or an abscess of the brain. In any of these vital organs the disease may of course prove rapidly fatal. Less dramatic results may, however, be observed; the arteries may be left permanently thickened, a cerebral vessel may be occluded and a permanent paralysis occur. Perhaps minor and less important structures may be involved in processes which may in no way reveal themselves nor incommode the patient.

It is perhaps worth mentioning that during the whole of this stage, which may go on for many years, the sufferer is quite harmless to the community. He may not be able to propagate healthy children, but he is certainly non-contagious and non-infective to the rest of the community.

Now that concludes the three classical stages of syphilis, and if we were dealing with any ordinary disease that would be the end of the chapter, but, unfortunately, with the insidiousness and treachery we have learnt to associate with this condition, we have to consider two further manifestations of the *Spironema pallidum*. A certain number of cases develop parasyphilis, which is divided into tabes and G.P.I. How many is not definitely known. What particular case will develop parasyphilis is also unknown. This much, however, is known: the most likely case is the one with the small painless chancre, often perhaps unnoticed by the patient,

the one which may miss the secondary and tertiary stages altogether. And so you have cases of tabes and G.P.I. who never knew that they had had syphilis.

Time is too short to say anything in detail of these two very interesting diseases, but certain points should be emphasized: they are caused by syphilis alone; they are of course really a late stage; they were until recently invariably regarded as fatal and, even with the modern malaria therapy, the greatest claim made is an amelioration of symptoms in about a third of the cases over a period of about ten years.

The interval between the original sore and the commencement of parasyphilis is an extremely variable one, ten to fourteen years, with an average of twelve, is the nearest estimate. Cases occur, however, as early as five and as late as thirty years afterwards.

It is interesting to note that syphilis, just like gonorrhœa, tends to settle down in overworked and damaged tissue, and so the manual labourer and the native of the East tend to get tabes, while the educated person, often the most brilliant and distinguished, develops G.P.I. In this connection it may be recalled that the soldiers who contracted syphilis in the third Burmese War of '85, in a country where tabes prevailed exclusively, developed in very many instances the G.P.I. which their superior civilization favours.

Differential Diagnosis in the Various Stages.

The next thing to consider is the differential diagnosis in the various stages. As a cardinal rule it should be laid down that no case should be diagnosed as syphilis without either a dark-ground examination and/or a positive Wassermann test. Courts of law recognize no others, and a clinical diagnosis is always to be avoided.

Primary Stage.

First the sore. The classical condition with which it may be confused is of course soft chancre. All sores should, in the first place, be regarded provisionally as syphilis, and it is our business to prove that they are not. Soft chancre is diagnosed solely by the exclusion of syphilis.

We can usually obtain a fairly good idea as to what particular sore we are dealing with by its clinical appearance, and I should therefore like to go into this in some detail. Placing them in parallel columns, we find the differences shown in Table I.

TABLE I.

Syphilis	Soft chancre
Usually single	Usually multiple
Painless	**Painful**
Non-inflammatory	**Very inflammatory**
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Rolling or flicking	No rolling or flicking
Bell-clapper penis	No bell clapper.
D.G. and W.T. positive	Negative

Notes on Table I.

Although in syphilis there is usually a single sore and in soft chancre multiple ones, it is quite common to see multiple hard sores and a single soft sore. In Constantinople I saw a syphilis case with six primary chancres on the shaft of the penis and the single soft chancre was quite a common phenomenon.

The signs in clarendon type indicate in my opinion the most important differences. Flicking or rolling: imagine a hard sore like a button introduced under the mucous membrane of the coronal sulcus. The foreskin is gradually withdrawn and at a certain stage the button-like mass suddenly flicks over.

The bell-clapper condition is one of non-inflammatory œdema of the lower two-thirds of the penis. It almost invariably indicates a concealed chancre under a tight foreskin. It is seen in syphilis only.

There are therefore some very striking differences and we can usually make up our minds, at least provisionally.

Soft chancre is quite a simple disease. But a great drawback is the great length of time required to heal the sore, particularly in the tropics. Buboes are a troublesome complication. A man is not really much the worse off for having had this disease.

Balanitis.—A partial or general inflammation of the glans and coronal sulcus. There is no actual sore or ulcer. Other tissues are very bright in colour, very red and painful.

Warts.—Not usually confused with a chancre, but may be so in the mind of the syphilophobe. They are very hard, raised, multiple and discrete ; they are due to lack of cleanliness.

Scabies.—This may require more care to diagnose. An isolated papule may resemble an early sore, but it is more raised, more inflammatory, and there are almost always other signs of the condition present, particularly scratching. The itching may be intense.

It is worth mentioning perhaps that scabies is the common cause of multiple chancres. The itch burrows prove excellent hiding places for the spironemes.

A case was seen recently in the Detention Barracks. There were several scabies papules on the shaft of the penis and mixed up with these were three circular areas of a dull bluish red colour with perfectly intact skin. The patient said they had been boils. They were sufficiently suggestive of recently healed hard chancres to warrant a blood test, which proved to be positive. I am quite certain this case would never have been diagnosed but for the fortunate co-existence of scabies. This man undoubtedly owed his comparatively early diagnosis to his "crime" and lack of cleanliness.

Herpes genitalis.—There is a group of minute painful vesicles on the glans or in the coronal sulcus. The picture is quite a distinct one and is only confused in the lay mind.

Dhobie itch.—An isolated patch of tinea on the shaft of the penis may cause some doubt. It is circular with a raised margin and other patches of tinea circinata are usually present.

Yaws.—One of the most interesting diseases in Dermatology, this condition is perhaps the most difficult to diagnose. In fact, it is almost impossible at times to make a diagnosis. Yaws is conveyed by contact; it has three stages; primary, secondary and tertiary; it has a spironeme indistinguishable from the *Spironema pallidum*. The Wassermann test is positive and the treatment is by arsenic and bismuth, just as in syphilis. It has these differences, however: a permanent cure is effected by about six injections; it is not congenital; and it does not involve the central nervous system. Its chief diagnostic feature is geographical, for it is almost entirely a tropical disease and limited to certain parts of the tropics, e.g., Malaya, the Far East and the West Coast.

SECONDARY STAGE.

Here we are confronted with many varieties of disease all of which more or less closely resemble syphilis, and people are often at their wits' ends to know which is which and what is what. In the short time available it is only possible to refer to the more important of these.

Let us take the rashes, the most baffling and bewildering of signs.

I propose to divide them into the usnal dermatological groups: macules, papules, vesicles and pustules. The first question which the dermatologist asks himself when confronted with a rash is--into which of these groups can the rash be placed?

Before considering these in detail let us get a clear picture in our minds as to the appearance of the typical syphilis rash. The roseolar macular is the earliest and most common. It may become papular and pustular later on, but we will consider the roseolar macular as the typical syphilitic rash. It commences as a faint blush of an indistinct mottled character, very pale, very inconspicuous. It is *in* the skin and not *on* the skin. Nearly all other rashes are *on* the skin. It gradually becomes more obvious, but it is always dull. Many adjectives have been applied, but the textbook description of raw ham is not very good. Our best adjectives are dull, sleepy, quiescent; and our best colour picture, pale brownish red. Nearly all other rashes are by contrast very active looking, very bright, and very obvious. Put in another way: one can easily overlook a syphilis rash in a poor light; any other rash is never overlooked.

Macules (RASHES FLUSH WITH THE SURFACE).

Drugs.—Drug rashes are fairly common and denote an idiosyncrasy. The chief are those associated with the administration of cubebs, copaiba, quinine, belladonna, turpentine and the salicylates. In the old days copaiba

used to be given for gonorrhœa. Once this rash developed, the patient, already under treatment for one variety of V.D., was then firmly convinced that he had another as well.

Now all these rashes are of a fairly bright colour, much more so than that of syphilis, they mostly itch and there is usually a history which helps. A salicylic rash from aspirin is not uncommon and a case occurred in the Cambridge Hospital last year.

Pityriasis rosea.—A somewhat uncommon skin disease, but one which resembles the roseolar macular rash of syphilis very closely. Diagnosis may be difficult. There is a herald patch on the front or the back of the chest and the rash spreads from this. There are fine branny scales and a good deal of itching. The colour is a rather bright pink. The general condition is quite good; the course is usually one of six weeks and it does not relapse. A Wassermann test is of course taken in cases of doubt.

The following circumstances illustrate the value of an immediate diagnosis. A lady suffering from pityriasis rubra was on her way from the North of India to Australia, and was anxious about the action of the immigration officials. A certificate as to the true nature of the rash enabled her to land without any question of syphilis being raised.

Seborrhœa corporis.—This is an extremely common skin disease with a rash in the "V" position in front and on the back of the chest. Two valuable points: the macules are always very pale and are covered with a faint, greasy scale. The picture, when once fixed in one's mind, can never be mistaken for anything else. There is practically always dandruff. Seborrhœic dermatitis is a similar condition only more generalized and more raised.

The Exanthemata.—Here we are of course only considering the macules. The infectious fevers most likely to be confused with syphilis are measles, German measles, scarlet fever and very early small-pox. In most of these conditions there is fever before or during the eruption, sharp fever, higher than in syphilis, a history of some kind, the presence of an epidemic, a really acute condition. All these rashes are very obvious, very red and inflamed and very active, and the patient usually gives a history of one, or perhaps two, days duration and sudden ill-health.

These are, of course, merely generalized observations, and each infectious disease has usually some particular sign or symptom which enables a diagnosis to be made. One further point I should like to make is that a temperature does not exclude syphilis, for nearly every case of secondary syphilis runs a temperature at some time or other. The reason for this not being generally known is that some of the older textbooks state that there is no temperature, and so it is never taken.

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Psoriasis.—A fairly common disease somewhat resembling certain forms of syphilis. There are many points of difference. The chief are given in Table II.

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Papules (or Raised Rashes).

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TABLE II.

Psoriasis		Syphilis
Extensor (backs of elbows, fronts of knees)	..	Flexor
Bright red	..	Dull red
Scales; dry, silvery, bleeding on removal ..	..	Greasy, dirty, no bleeding
No other signs of syphilis	..	Other signs present
Itching..	..	No itching
Very chronic	..	About eight weeks
Dark-ground and Wassermann tests negative	..	Positive
Not affected by antisyphilitic treatment ..	..	Clears very rapidly

Dhobie itch.—The typical situation does not usually cause any doubt, but tinea circinata of the trunk or limbs may do so. Here the ringed outline and the raised margin give the diagnosis.

Scabies.—Bright red, intensely irritating papules, with scratch marks, present a perfectly clear picture.

Papillomata.—These in the region of the anus are common, and are apt to cause very great doubt as to whether they are due to syphilis. Mistakes are frequent. Soon after my arrival in a certain foreign station, I had to deal with a case where the growth around the anus was as large as a small cauliflower, and I found it had already been diagnosed as syphilis. A spironeme was said to have been found in a stained specimen. This method of looking for the organism is never very good, and mistakes are quite common. I went to the particular civil laboratory where the examination had been made, and asked to see the specimen. I am quite sure that the object thought to be a spironeme was a twig or fibre or a bit of dirt. They were not in any way surprised when the Wassermann test had been negative, but they were really shaken to the core when six injections of arsenic failed to reduce the mass. I had no course but to change the diagnosis of the case, which was ultimately dealt with surgically and without relapse.

Piles.—Piles are without doubt the most frequent source of diagnostic error. One sees quite a number of these cases and the results are often disastrous. The difference between the two conditions is quite simple. The condyloma is always a moist flat-topped papule, almost always symmetrically distributed on the two cheeks of the buttocks, and usually foul in appearance and odour. The pile by contrast is round topped, dry, somewhat compressible and varying in size from time to time and of very long duration. Further, condylomata are quite painless whereas piles may be very painful. One further point in syphilis of the anal region: the outer third of the inguinal glands is frequently enlarged, an anatomical fact not always appreciated.

It is worth mentioning that condylomata are exceedingly contagious and contain so many spironemes that the dark-ground examination is very easy indeed. Further, condylomata are perhaps the most frequent source of innocent infections from latrine seats, towels, clothes, etc. They may also occur under the breasts in women where the moist heat is favourable for their growth.

Vesicles.

To continue our logical classification of these lesions we have to consider the vesicle, but this form of rash does not really occur in syphilis as the papule proceeds straight to the pustular stage. Some people have thought, quite erroneously of course, that syphilis may show a vesicular form and a case which I saw in a certain station abroad exemplifies this. The common diseases are of course chicken-pox and early small-pox.

On entering the ward to see this particular case I was greeted with all the paraphernalia of an infectious hospital, gowns, masks, etc. On examining the patient one found that he was covered from head to foot with a pustular rash (rupia), had a general adenitis, and a severe laryngitis with partial loss of voice; he had run a continuous temperature of 101° to 102° F. for six weeks and had lost one stone in weight. He had been diagnosed chicken-pox, but it had recently been changed to small-pox. Would I kindly confirm?

Blood for a Wassermann test was taken that day and was reported on the next. It was found to be strongly positive and the patient was transferred to our special hospital. He was given treatment at once and his temperature dropped to normal within twenty-four hours. He improved rapidly, gaining ten pounds in a fortnight and was discharged to duty on the sixteenth day.

This case illustrates several things: (1) The importance of accurate clinical guidance, i.e. to know when to take a blood test. (2) To keep syphilis constantly in mind, especially in a chronic condition. (3) The recognition of continued pyrexia in secondary syphilis. (4) The rapid improvement once the appropriate treatment has been given.

Herpes zoster.—This is a vesicular condition which might be confused with syphilis. The typical group of vesicles on a painful and inflamed base usually preceded by definite pain on the nerve track presents a perfectly clear picture.

Herpes labialis and facialis.—The condition known as a "cold on the lip" by the lay person resembles the primary stage of syphilis more than the secondary, and is often confused with it. That is to say the extragenital sore may easily be regarded by both doctor and patient as merely a cold on the lip. The painfulness of the one and the painlessness of the other usually afford valuable evidence.

Pustules.

Pustular syphilis or rupia may be confused with two common conditions.

Impetigo contagiosa, which is of sudden origin and limited to the face, neck and scalp.

Acne vulgaris, which is exceedingly chronic, limited to the face and back, and is so well known that it can be dismissed without comment.

(*To be continued.*)

OBSERVATIONS ON THE ÆTIOLOGY OF RHEUMATISM.

By Captain N. GRAY HILL, *M.C.*,
Royal Army Medical Corps (T.A.).

Rheumatism is a very evasive subject to deal with, and in spite of the interest that has been focused upon it and the painstaking search that has been made for the causative organism, really very little is as yet known concerning the ætiology of the disease. There is little agreement as to whether there is any real connection between the more chronic rheumatic or rheumatoid diseases that are met with chiefly amongst adults and only rarely seen in children, and the more acute conditions that are chiefly diseases of children and young people and come under the heading of juvenile or acute rheumatism, chorea, rheumatic carditis and rheumatic fever. There seems to be a tendency for the clinicians to differentiate these diseases into two main groups, but there are many who would follow the teaching of Sydenham and regard them as being very closely allied or even phases of the same disease.

Pathological investigations afford substantial support for the view that the various rheumatic conditions are but manifestations of one disease, the brunt of the attack tending to fall on the heart in children and on the joints in adults. But in both the disease is widespread in the body, and it is rather variable in the way it makes its presence shown. If the Aschoff body is the characteristic lesion of rheumatism and of real pathological significance, then acute rheumatism, together with rheumatoid arthritis, Still's disease, and certain other forms of chronic rheumatism must be regarded as having a common ætiology.

Now, turning to the disease that for want of a more satisfactory name we must call acute or juvenile rheumatism, although it is really a disease of a very persistent, subacute or recurrent nature, and is not strictly confined to children, we have a condition characterized by attacks of transient arthritis and chorea and a more or less progressive carditis. All three of these conditions are rarely present at the same time, and in many cases the diagnosis must be made on the discovery of any one of them. Prolonged observation of the patient will only too frequently show the development of the other two, as well as other less common or less typical signs of the disease, and this in spite of any therapeutic measures that may be taken.

Many theories have been advanced as to the chief ætiological factor in the causation of acute rheumatism. It is generally assumed that some organism must be responsible and there are those who hold that it is caused by the bacillus described by Achalone, or by protozoa, or by a filter-passing virus, but the opinion now most in favour is that the

disease is associated with an infection by some type or types of streptococci. Since the end of last century the streptococci have been suspected as being the causative organism, and quite a strong case was made out against the streptococci of the viridans type. This view was held in the British Medical Association report published in 1926, as a result of the work of a sub-committee dealing with rheumatic heart disease in children. The committee reviewed the recent investigations that had been made into the bacteriology of rheumatic infections and the conclusions arrived at were that there was no rival to the streptococcal theory, and the only difficulty was to place and accurately describe the rheumatic streptococcus, a non-hæmolytic coccus that apparently resembled the *S. salivarius* very closely. The hæmolytic streptococci were but briefly mentioned in the report.

Research done since 1926 seems to have tended towards the acquittal of the viridans group and turned suspicion upon the hæmolytic organism. This change was in the first place largely due to the work carried out in America, notably by Swift and his collaborators; and most of the more recent researches, both in England and America, have pointed the same way.

Now, although there are strong grounds for suspecting that the hæmolytic streptococcus plays a part in the causation of acute rheumatism, proof that it does is definitely lacking and while further bacteriological research is of the greatest importance, it may be well to review any other ætiological factors that concern the disease, and see what light they may cast on this obscure problem.

As Tertius Clark has pointed out, one of the few observations concerning acute rheumatism that is agreed to by all investigators is that the disease does not occur in the low-lying tropical countries at the present day. In the hot sub-tropical countries the disease is known, but in the territories lying between 23′ 28″ N. and 23′ 28″ S. it does not occur. If a satisfactory answer could be given as to why the people inhabiting these regions are free from active rheumatism, a real step forward would be made in our knowledge of rheumatic diseases.

It would appear that it is not simply a question of racial susceptibility to acute rheumatism. Although the question is not yet finally settled, it would seem that all races are susceptible. As with almost all other maladies there are probably definite variations in the severity of the reactions and the degree of resistance shown by various peoples, classes and communities; but the general result of the work of the American investigators carried out in the large cities of the north of the United States suggests very strongly that when people of the various European nations, negroes and Chinese live under conditions approximately the same, they all suffer from acute rheumatism and show all its typical manifestations.

It has been stated that the Chinese living in China and the native population of Africa are immune from acute rheumatism, but several

recent publications have thrown doubt on this, and suggest that this immunity is only partial if it exists at all. It would seem probable that in a country such as China, there must be a large number of the children in indifferent health who, if they lived in England or America would receive serious attention and be regarded as cases of subacute rheumatism, may be passed over unnoticed in the presence of more serious and more obvious pathological conditions.

Even in countries where fairly elaborate statistics relating to public health are kept, the available information is very limited when we turn to those diseases that do not occur in spectacular epidemics and do not cause immediate death. Diseases such as acute and subacute rheumatism are too indefinite to allow of compulsory notification, and statistics relating to deaths due to cardiac disease will not be identical, or even in strict relationship to the incidence of rheumatic carditis.

In the past it has only been on rare occasions, such as a general mobilization, that a large proportion of the population has been examined medically and the findings recorded numerically. There can be little doubt that the findings of the medical officers examining recruits during the Great War did much to show us the appalling amount of rheumatic heart disease that was present in this country. With the further extension of the public medical services and the facilities for the medical examination of children on lines such as have been developing during the last few years in almost all parts of the world, it may be hoped that more exact knowledge of the health of the citizen will in the future be available, but for the present the information to be had in most countries is very meagre. Fuller investigations may show a fairly widespread prevalence of acute rheumatism in China and other parts that are at present believed to be free of the disease.

If, however, further researches go to substantiate the view that in China rheumatism is rare or unknown amongst the native population, it is a point of great interest. Any natural immunity they may possess is not carried by the Chinese who emigrate, and this would suggest that the absence of the disease must be due either to some local climatic condition or to the absence of the causative organism and consequently the chance of infection. Likewise if it is proved that the negro population inhabiting large districts in Africa are free from the disease the reasons must be local, the immunity can scarcely be racial. Descendants of the same stock living in the United States of America are very prone to develop rheumatism; some observers believe them to be more susceptible than the white population in the more northern States.

Those who believe that acute rheumatism is the outcome of infection by hæmolytic streptococci lay emphasis on the fact that organisms of this type have, in the past, rarely been found in tropical countries. Coburn has carried out most careful work bearing on this point. He had cases of acute rheumatism transported from New York to Porto Rico and showed

that as they approached the tropics and while they lived in Porto Rico the hæmolytic streptococci disappeared from their throats and the patients became free from all signs of active rheumatism. Return to the northern climate was associated with both the return of the hæmolytic streptococci and the recrudescence of an active rheumatic disease.

A more exact knowledge of the geographical distribution of the hæmolytic streptococci and more especially of those strains that have been cited as being associated with acute rheumatism, would be of the greatest interest.

In this country it is very difficult to appraise the influence of the hæmolytic streptococci; they are too prevalent. It is commonly believed that erysipelas, scarlet fever, acute tonsillitis, puerperal fever and other less well defined diseases are the result of infection by certain strains of hæmolytic streptococci that apparently resemble each other closely; but in addition it would seem that a large proportion of our population is composed of people who are, at least for some portion of the year, "healthy carriers" of identical, or almost identical strains of streptococci. So we must formulate the hypothesis that most of us develop a fairly high degree of resistance to the toxins or other noxious substances produced by these streptococci. The problem is abstruse, and the exact role of the pathogenic streptococci hard to allot.

The diseases that have been ascribed to streptococcal infection seem to be influenced by environment and locality. Scarlet fever, like rheumatism, is unknown in the tropics, and Bach has pointed out that in different countries acute rheumatism seems to take rather different forms, locality having the greatest influence, the economic circumstances being of but secondary importance in determining the most prevalent manifestation. The distribution of erysipelas and puerperal fever seems to be less well known, though the former is commonly associated with poverty.

The class distribution of juvenile rheumatism has been mentioned by many observers and the view was at one time held that in England the children of the wealthier classes were almost immune to the disease, though further investigations seem to have thrown doubt on this. Glover and Bradley have given instances where rheumatism has occurred amongst public school boys during recent years.

Like scarlet fever, juvenile rheumatism seems to change its form during a period of years. A definite cycle of rise and fall in the severity of the attacks has not been worked out with the precision possible in the case of scarlet fever, but it probably occurs. The disease that Cheadle so clearly described as being prevalent in London towards the end of last century is now rare, and almost unknown in London to-day; but in New York and certain other of the eastern States of America a disease similar to that described by Cheadle appears to be prevalent at the present time.

Many attempts have been made to show that acute rheumatism is an epidemic disease, and though endemic in most parts of the world it has

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Many attempts have been made to show that acute rheumatism is an epidemic disease, and though endemic in most parts of the world it has

been regarded as liable to occur in epidemic form. Epidemics of acute tonsillitis caused by certain strains of hæmolytic streptococci have occurred amongst children either known to be rheumatic or believed to be healthy, and exacerbations of rheumatism or the development of an initial attack has been thought to follow the epidemics; but the number of these outbreaks that have been reported has not been large.

It would be interesting to know if there has ever been a local epidemic of acute rheumatism occurring suddenly in an isolated community, such as the inhabitants of a lonely island or very secluded valley. A detailed report of a localized but severe rheumatic epidemic would be invaluable—with the rapid development of modern transport an isolated community will soon be a thing of the past.

Although acute tonsillitis caused by hæmolytic streptococci is highly infectious, acute rheumatism seldom, if ever, spreads through a family or school in a way really analogous to scarlet fever or measles. Paul has made a very close study of the subject and with the help of ingenious charts brought forward evidence to show a certain infectivity of the disease; he suggests that while some members of the group develop frank rheumatic fever, others show the indefinite or very subacute manifestations of the disease. Further work on the lines suggested by Paul would be interesting but very difficult to carry out, the personal factor is apt to play a large part and it is almost impossible to reduce the findings to a fair statistical basis.

Dissatisfied with the poor results obtained by investigation based on the assumption that acute rheumatism is an infectious fever caused by an organism that only awaits discovery, some investigators have turned their attention to other possibilities. The influence of diet and of the content of the food has been closely examined. The work is still in hand and the question not yet settled; but recent publications do not suggest that research along these lines is going to point to the primary ætiological factor.

It is true that a very ill-balanced diet or one grossly deficient in vitamin A may predispose to the onset of acute rheumatism, as it may to many other diseases, and there can be no doubt that an ample but simple and well-balanced diet is an essential adjunct to the successful treatment of juvenile rheumatism; but this again is true of such a large number of diseases of such very varied origin that it can scarcely be taken as of great significance when dealing with the knotty problem of the causative factor.

Warner's work dealing with the administration of vitamins A and D to children known to be rheumatic, would suggest that the belief that rheumatic children are definitely deficient in these vitamins is ill-founded.

Acute rheumatism is a disease that has not in the past been associated with famine and actual starvation, nor is it recorded as occurring in persons subject to great hardship and privation. The staple diet in different countries may have something to do with the various manifestations of the

disease that have been noted, and it is possible that the better feeding of the population has had an influence in reducing the fulminating attack which the older writers seem to have considered as characteristic of rheumatism, but up to the present we have no exact knowledge on this point. It is worthy of further investigation. The causation of acute rheumatism is still an open question and nothing that may have bearing on the subject should be discarded without careful examination.

CONCLUSION.

At the present time, the view most commonly held is that the hæmolytic streptococcus is closely associated with rheumatism. That it is the causative organism has not yet been proved, and it is even possible that further clinical or laboratory investigations may place the whole rheumatic problem in a very different setting.

DOWN SOUTH.

By U. P. A.

IV.—Though Every Prospect Pleases . . . .

(*Continued from p.* 211.)

It has already been said that, although we never saw him, yet we believe that there must be at least one soldier in Colombo.

The absence of khaki certainly makes for a brighter Ceylon.

When the Royal Navy painted its ships a drab grey, it did not clothe its personnel in the same depressing hue; but when we abandoned red and blue and white, we abandoned them for ever—or so it seems.

Than khaki—and especially the home variety—what shade is more hideous?

Too little heed is paid to the influence of colour. Colour is a potent factor for evil or for good. It is easy and pleasant to conjure up the romantic possibilities inherent in Guards' scarlet, rifle green, horizon blue, field grey and even in Nazi brown; but what sort of visions can be woven into a tint suggestive of nothing more inspiring than painter's putty, sprue and peasoup?

That is the worst of putting your trust in a department; sooner or later it will let you down. A department is a soul-less unimaginative machine; and when it names its products backwards you may, with confidence, prophesy disaster. In its hands you are not merely lost, you are damned

Some day the process will be carried a step farther, and we shall wake up and find ourselves clothed in ikahk.

At first sight there would seem to be little harm in talking of "degchis, aluminium, nests of, one"; but that kind of nomenclature is death to art; and colour is art.

It is intolerable—nay, it is outrageous—to think that, before long, our board papers may bear the entry, "Fracture, septic, comminuted, compound, tibia of, left"; or that our gallery catalogue may contain a "Lisa, Mona."

"Degchis, aluminium, nests of, one" belong to the marine store dealer's hardware cum haberdashery department, whereas uniforms should be a matter for the guilds of arts and crafts.

If the designers of Army clothing would but resign in favour of a suitable committee or board, we should be delighted to wear khaki "until present stocks are exhausted," in anticipation of favours to come: of favours as far as possible removed from putty, sprue, peasoup and hybrid Homburgs. Now is the time, when clothing—and especially the hat—is in the melting pot.

There should be no difficulty in forming such a committee or board: one which has never heard of nests of aluminium degchis backwards; one, for example, composed thus:—

President: The Matron-in-Chief.
Members { Dame Laura Knight.
Mrs. Mellanby.
Miss Gracie Fields.
The junior subaltern's wife.

There can be no doubt that the deliberations of these ladies would result in a dinky little *chapeau*—instead of a pensile piece of puttoo—and a colour both practical and *chic*; a colour as invisible to the enemy as it would be attractive to the ladies; a colour in which we could take an abiding interest and a personal pride.

Does such a colour exist?

Yes, it does. It is called beige; and the adoption of beige by the male portion of the Army would have the additional advantage of freeing the Army's wives from a tyranny which has endured far too long.

Personally, I shall take some time to adjust myself to a beige-less Georgina; but, after all, I managed to survive the shock of a sudden shingle: and it is comforting to reflect that Georgina divorced from beige can hardly be so immediately devastating as Georgina minus her locks.

It is said that the drawback to beige lies in the fact that 101 shades of this colour are met with between "Desert Sand" and "Pulverized Brick"; but, in practice, this is merely an academic defect, since neither I nor any man I have met can distinguish one shade of beige from another.

On the back of an old route book I find the following jottings:—

"In the afternoon the road to Mount Lavinia is crowded with homing schoolchildren: a terror to the motorist."

"Colombo has a number of palatial public and commercial buildings, erected in the boom years following the War, when tea and rubber were marketable commodities."

"Four mail ships in harbour. Hotel swarming with millionaires from Sydney, Singapore and Shanghai. Heavy run on the cocktail department."

"Electric storm extending out to sea. As darkness fell, a magnificent spectacle."

"The secretary and staff of the Ceylon A.A. are most courteous and helpful."

"Head waiter rebuked for studied inattention. He seemed hurt. Perhaps waiters who wear out-size combs should be regarded as beyond reproach. This rude fellow had three combs as big as *Cutty Sark*'s main t' gallant sails."

These roving, random entries reflected the family state of mind at that time. We were in the doldrums, without a plan, and unable to come to a decision.

Originally, we had meant to carry out a circular tour of the island, and to finish our leave in the central highlands. However, the run south from Manaar and the stay in Colombo had taught us that, on the approach of Easter, the coast of Ceylon is an unpleasant habitat.

"The so-called hot weather, the inter-monsoon period of March, April and May, owes its disagreeableness not so much to the temperature, which, on the average, is very little above that of the rest of the year, as to the lack of wind at that time. At the coast, the sea breeze mitigates the discomfort during the day, but at night the breeze dies away, and the weather is often very trying."

Judged by the Indian standard, it was never hot. In the lounge of the Galle Face Hotel, and under a racing fan, it was delightfully cool and pleasant; but away from the strong draught of the fan it was beastly: warm, humid, oppressive. You dripped in your bath, dripped in a vain attempt to dry, dripped in donning fresh clothing, dripped in changing into a second lot of fresh clothing, and dripped in no clothing at all.

It is at times such as these that The Hearty Hoodoo usually turns up. He approaches wiping a large, flabby forehead with a large, coloured handkerchief. Everything about him is large, from his manner to his beads of moisture. A large slice of neck is revealed by the drooping of a limpid collar, and over the small of his back a large, wet patch disfigures his white suiting. With a large smile and a large voice he trumpets: "Just the thing for your sweat glands, my boy. The annual Turkish Tonic, I call it." He expects the answer: "Quite so; and what's yours?"

Pah! May he perish of a sudorific plague!

Reluctantly we realized that an extended tour under conditions approaching a reasonable degree of comfort was out of the question at that time of the year. We therefore decided to make for the central hill tracts at once.

Leaving Colombo on March 17, we passed through Kelaniya—one of Ceylon's most ancient capitals—and from thence to Mahara, where British troops were quartered in the old days.

The town of Gampaha (Heneratgoda) lies eighteen miles from Colombo. Here there is a botanical garden of much historical interest. In 1876 Sir Henry Wickham brought seeds from the Amazon to Kew, where germination was carried out. In due course 7,000 young plants were sent by Sir Joseph Hooker to Ceylon. They were planted at Heneratgoda, which thus became the cradle of the para-rubber industry in the East. Some of the original trees, now of gigantic proportions, are still to be seen here.

The usual well-made but narrow road switchbacks through a fertile, picturesque country until, at the 59th milestone, it traverses the village of Ganetenne. This place is 670 feet above sea-level, and from it the road climbs to the head of the Kadugannawa Pass—an ascent of 976 feet in three miles.

Ganetenne means, "The place of the priests." The story goes that, in the closing years of the sixteenth century, Raja Sinha I of Sitawaka here assembled a large number of holy men and addressed them thus: "I have murdered my father and now desire to expiate my crime. How may this be done?" The religious answered: "Your crime is beyond expiation." This so enraged the Raja that he caused the good men to be buried up to their necks. He then had their heads ploughed off.

A gruesome yarn; but the ending has a veracious sound: so true to life. A man who has murdered his father should be treated with circumspection.

The climb to Kadugannawa (elevation, 1,646 feet) is inspiriting, and the views are grand—provided you are not in the driving seat. The head of the pass is the scene of a battle fought between the unpleasant Raja mentioned above and the Portuguese soldier Don Juan. Here, too, there is a prominent, if not beautiful column, erected in 1832, in memory of Captain Dawson, the maker of the road.

Just short of the summit the road pierces a huge rock. Tradition says the Kandyans believed that, when this rock was penetrated, the Sinhalese Kingdom would come to an end; and so indeed it befell. This reminds one of the Sikh guru's prophecy regarding the coming of the *topi-walas*.

Our people do not pay sufficient heed to occult signs and portents: and this despite the fact that these signs and portents are not difficult to recognize or to interpret. For instance, my name is enshrined in a certain book which is enclosed in covers of a pale and sickly pink. During some tours of duty as O.M.O., and with the expenditure of a little thought, I discovered that, if the owners of about two hundred names which are printed above mine die, or are killed, court-martialled or otherwise disposed of *in time*, I shall be promoted—always provided, of course, that I ——.

However, that is of no consequence.

The point is—well, you see what I mean? A little Kandyan or Sikh foresight, and life—even one's future life—is made so much easier. It is hard to understand why more advantage is not taken of this simple aid to happiness; but then—the West is so superior: it never will condescend to learn from the East. It merely says, "Bunk!" and leaves it at that. What a mistake!

Four miles short of Kandy, and sixty-eight miles from Colombo, we pulled up at Peradeniya Resthouse. This house is situated at the entrance to the golf links, on the edge of a racecourse and in front of a famous botanical garden. It is, therefore, a resthouse of importance; and it is fitting that its management should be in the hands of a person of substance and ability.

Many years ago my library included a child's bible. It was full of vivid illustrations; and even at that tender age my later interest in

surgery was evidenced by the fact that one of these illustrations exercised a peculiar fascination over me. This was a picture entitled "King Solomon." His Majesty was somewhat like the Father Neptune often depicted in the pages of *Punch*: tall, broad-shouldered, venerable and hairy, with flowing locks and an immense snow-white beard. He was clad in a long, white nightshirt, over which was thrown a dark cloak. His right arm, bared, was raised above his head: the hand clutched a short heavy sword. The latter looked exceedingly sharp. His left arm was outstretched horizontally: the hand grasped the ankle of a baby which dangled in mid-air, head downwards. The baby was a plump one. Obviously, His Majesty was on the point of cutting the poor little mite in halves. The distracted mother, on the floor, had pinned the King with a very good ankle tackle. In the background a second woman was in hysterics. Certainly it was a striking picture.

Well, as soon as the headman of Peradeniya Resthouse appeared, I knew that the King Solomon of my child's bible had come to life. He even carried a short sword, like the *kirpan* of the Sikhs, and wore a crown in the shape of three huge and most elaborate combs. Of course we christened him Old Sol.

Tiffin was somewhat protracted because, between each course, Old Sol strolled into the dining-room:—

(1) To explain his descent from the old royal house of Kandy.

(2) To explain why he had been appointed keeper of the Peradeniya Resthouse, instead of custodian of the Temple of the Tooth.

(3) To induce us to buy his tea—his own growing, he said.

(4) To inveigle me into purchasing his cigars—his own manufacture, he declared.

(5) To interest us in various sidelines, such as carved wood, chutney, ivories, jams and so forth.

The tea was excellent, but the cigar was—well—too much for me, by several inches. In spite of that, Old Sol might have overcome our resistance had he been a little less ostentatious and cocksure. Instead of talking to us, he talked at a large mirror, before which he paraded his imposing presence like a gigantic bird of paradise. He adjusted the folds of his flowing garments, corrected the carriage of his *kirpan*, rearranged his coiffure and smoothed down his wonderful beard. At first all this was amusing, but, as time passed, it became irritating. Finally, I declined to buy even a diminutive pot of honey, and Georgina swore that nothing on earth would induce her to look into the same mirror, even if she were condemned never to wear a hat again.

We strolled across the links and marvelled at the courage of those who risked their necks on the dangerous looking racecourse. We agreed that the jockeys are probably the indigenous chauffeurs. Then we went into the botanical garden, and this we found delightful. This garden was founded in 1823 by Alexander Moon. It is 143 acres in extent and is

traversed by the river Mahaweliganga. Even if you are not much interested in gardens, visit this one, should you be anywhere near Kandy.

We were admiring a fine clump of trees, and I was telling Georgina that, although snakes are quite common in Ceylon, they are unknown in the Peradeniya Botanical Garden. "Who told you?" she inquired. "The guidebook," I answered. Georgina stood still and mused: "Very curious," she said, "then what is that?" She pointed to a moving object only a few feet away. It was a long, brown snake. It wriggled rapidly over the ground and disappeared in a hole at the foot of a great tree.

Cobra or krait? I don't know. I once saw an Irish officer of ours "beating it up" in a bunker. He was a golfer of the earnest, forceful type and red-headed. "Have mercy on the poor little ball," I called out; "after all, it's your fault." "It's not a ball, sorr, its a great [whack] b—y shnake." Of course I asked the customary inane question: "Is it poisonous?" "Can't tell, sorr [whack]. Th' way you'd be ascertain' that [whack-whack] is ahfter the divil's a corrpse" [almighty and final whack]. Sound advice, when you come to think of it.

Peradeniya was warm and sticky, and the night's rest was anything but refreshing. Next morning Old Sol presented us with a very stiff bill. With the aid of the printed tariff I was able to defeat him with ease, and he accepted the legal tender smilingly and without a murmur.

A run southwards of 12½ miles brought us to Gampola—a place which, in India, would be known as a "second-class hill station," i.e., a place which is slightly elevated above the surrounding plain, hot as Hades, innocent of fans and ice and full of grouses. It is said that a cooling breeze sometimes visits a second-class hill station; but as this is alleged to occur between 2 a.m. and 4 a.m., it can hardly be counted as a practical amenity.

Gampola is of some historical interest. Under its old name, Gangasiripura, it is mentioned as far back as 500 B.C.

Here the road forks: on the left, the direct hill road, via Ramboda, to Nuwara Eliya; and on the right, the valley road which follows the course of the railway, Nawalapitiya-Hatton-Nuwara Eliya. We chose the latter, and enjoyed a wonderful drive through acres and acres of tea, over a road incredibly narrow and tortuous. The countless rows of myriad tea bushes are so meticulously neat, tidy and formal, and the road and its windings are on such a diminutive scale, that you are made to feel as if you were in toyland. You decide that you ought to be dressed as a Japanese doll and be mounted on a skooter.

Seventeen miles from Gampola the road joins the main Colombo-Nuwara Eliya motor highway at Ginigathena. The pass here, at the head of the Kelaniya valley, rises to 2,185 feet. Near by are Dikoya and Watawale, well known for the excellence of their teas. Much has been, and could be, said in praise of good tea; but little or nothing has been said in disparagement of tea factories. These factories form prominent marks—

or, rather, blots—on the landscape. They are huge and hideous, and though their walls are grey and their roofs red, they look utterly out of keeping with their surroundings. Occasionally an attempt is made to hide their ugliness by means of creepers, shrubs and flowers; in one instance we saw a fine display of canna lilies; but, as a rule, the gaunt, rectangular buildings are perched in all their naked utilitarianism on the most prominent natural features of the areas they serve. Were they fashioned after the Swiss châlet or Scots baronial style, their presence might be excused; but the style of the Lancashire mill and the Lanarkshire foundry matcheth not the hills and dales of Ceylon.

However, as the mill and the foundry have proved equally—or even more—destructive of the beauties of the Ribble and the Clyde, it ill befits us to be over-critical.

Hatton Garden is 31 miles from Nuwara Eliya. The Tamil name for this place is Topi-Totum (topi = hat, and totum = garden. It is requested that this striking piece of information be received in silence).

Hatton is the jumping-off place for Adam's Peak, via Maskeliya. By this route the distances are: by car, 42 miles; on foot, 4½ miles, followed by the final ascent over a very steep, rough track, to an altitude of 7,360 feet. The climb is best done by moonlight, and is usually undertaken between January and March. Georgina and I decided not to essay the task, as there are no military officers' hospitals in the island.

On the summit there is a temple, with a high priest in charge. There is also a foot-print which—the Buddhists say—was impressed by the Lord Gautama when he alighted on the peak, on one of his three visits to Ceylon.

The Mussulmans ascribe the foot-print to Adam.

It is a bad thing to become involved in religious controversy, and happily, in this case, there is an easy way of escape. We may ignore the battle of the foot-print by referring to Adam's Peak as Samanalakanda, or Butterfly Hill—so-called from the myriads of butterflies which pass annually southwards across the island, and which are believed to be bound for the peak.

"The view from the top of the mountain is wonderful on a clear day. The visitor should try to get up in time for the sunrise, and see the shadow of the peak thrown to westward, lying like a huge, dark cone across the country—an extraordinary apparition."

Nuwara Eliya was reached in time for tea: distance from Kandy, by this route, about 107 miles.

"Neuralia"—to give it its abbreviated name—lies in a valley at the foot of Ceylon's highest mountain, Mount Pedro, 8,290 feet. It is to the island what Gulmarg is to the Punjab, or Ootacamund to Madras—the refuge and rendezvous, in the season, of youth, beauty and fashion: the Mecca of golfers: the Arcady of amateur actors: the Helicon of jazz. In Neuralia the season extends from January to May, and everybody who aspires to be anybody tries to be there in April, at any rate, when the big race meetings

and championship tournaments are held. But, as the Ritz in London is much the same as the Ritz in Paris or New York, it is unnecessary to say much about Neuralia to those who have "been there before." In the bar the crowd stands on your corns—or its absence makes you feel chilled and lonely. You say: "What an insufferable mob!" (or "This place is played out now," as the case may be). Then you always add: "I'm for the U.K. on my next spot of leave: true bill."

Talking of leave to the U.K., have you noticed how the chairmen of British companies are grumbling, because many Army officers and Government officials of sorts book their passages by foreign lines, even when these passages are State paid?

The other day the Retrenchment Committee of the Mugwump Presidency published its report. The report was introduced by a foreword by the chairman, Sir Jack Union-Jack, C.S.I., C.I.E., late Salt and Atta Commissioner with the Mugwump Presidency. The foreword (according to the newspapers) ran something like this:—

YOUR EXCELLENCY.—*The recommendations of Your Excellency's Retrenchment Committee will, in themselves, effect little or nothing. We find, however, that they are likely to be productive of great good, provided there is a return to the gold standard, a complete cancellation of all international debts, total and universal disarmament, a widespread epidemic of confluent goodwill amongst all peoples, and a wholesale reduction of tariffs to zero or less. Meanwhile we humbly draw Your Excellency's attention to the paramount importance of our* FIRST *recommendation, viz.*, LET BRITISH BUSINESS BE CARRIED IN BRITISH BOTTOMS."

You agree that this inspiriting introduction augured well for the rest of the report?

Unfortunately, at the foot of the report, some tactless compositor had inserted the following paragraph:—

"DEPARTURE OF A POPULAR COMMISSIONER."

"Immediately after publication of the Retrenchment Committee's report, Sir Jack Union-Jack, C.S.I., etc., left our shores on leave, pending retirement. Sir Union-Jack was waved farewell by Babu Mukandbhoy and staff, Salt and Atta Dept. Sir Union-Jack graciously inspected the Saltpan troop of Boy Scouts, and permitted himself to be garlanded by the Atta Gumbah troop of Girl Guides. As Sir Jack, C.S.I., clomb gang-planks, police band, Mugwump City, played Albanian National Anthem. Ship's band obliged by playing 'Old Wiliyati rosbeef.' At head of gang-planks, El Capitano Dante Gabriel Rossetti received Sir Jack Union-Jack with profound Albanian salaams. The *Visconti Vermicelli* (Albanian State-subsidised Steamship C oy.Ld.) blew off steam at 1400 hours, and so melted forever our respectable commissioner sahib—R.I.P. On arrival in Europe, Sir Union-Jack proposes to cross from Hamburg to Harrogate by a Lufthansa Gesellschaft Stuntjabriken air liner."

With certain modifications in phraseology, this was copied by all the newspapers in the country; but it was too late: Sir Jack had got safely away with it.

To return to Neuralia: if you expect to play golf there be prepared to pay for it. A visitor is charged six rupees (nine shillings) per day. I ventured to remark that it seemed rather a lot, especially as, after rain, the course became unplayable; and when it is not a swamp, the rabbits are warned off to make way for the pot hunters. My remark was answered thus: "Have you ever played, as a visitor, on a London course?" Well, that silenced me: I had not thought of London . . .

So we had an orgy of race-going.
That—but no: let us draw the veil.

We stayed at the Hill Club and were most comfortably housed and well fed. This admirable and hospitable institution permits officers on the active list to enjoy all the benefits of membership on very generous terms, and to its kindly secretary and charming members (nearly all civilians) our warmest thanks are due.

But the Hill Club did more than look after our physical well-being: it also provided us with mental relaxation and refreshment.

In our short and infrequent spells of leave (by the way—how comes it that everyone always contrives to get much more leave than either you or me?) Georgina and I have been more interested in Nature and the arts, and in similar impersonal things, than in our fellow—usually foreign—creatures: we have depended on each other for companionship.

However, on this occasion we found ourselves in a different and stranger world, where everyone was friendly, where conversation turned on tea and tariffs, coffee and company promoting, rubber and real estate: where sergeants were classed with sea-serpents and "orderly duty" was as mysterious as the inside of a German sausage; and where the natural vehicle of whisky was water. Of course, many of the men had served in The War, and not a few still smoked virginian cigarettes; but now their soldiering was but a memory as nebulous as that of a first love: a thing which had happened as in a fairy tale, once upon a time.

Undoubtedly it is good for us to discover that there are numbers of sensible and substantial citizens of the Empire who are much more interested in shares than in soldiers, and to find that they regard you as a sort of *objet d'art*—a thing which is nice to have about the house, but which need not be taken too seriously.

Several delightful trips may be made from Nuwara Eliya. You may take the steep descent through the Sita Eliya gorge (where Ravanna held captive the Princess Sita, who ultimately escaped by way of an underground passage) until, at the sixth milestone, you arrive at Hakgala Botanical Gardens. This garden was opened by Sir Clements Markham,

in 1860,as a chinchona plantation ; but it is now full of the most beautiful flowers, rock plants, shrubs and trees. The lay-out has been done with great care and artistry. The garden is on a steep hillside, at a height of 5,600 feet, and the views are grand : an enchanting spot.

Or you may pack your tiffin basket and make east, and then south, to Haputale—36 miles away—via Welimada and Bandarawela. This is a thrilling drive through some of the best of Ceylon's mountain scenery. A few miles to the west, between Bandarawela and Haputale, there is a hot weather camp for the personnel of the East Indies Squadron. The former is a favourite resort, with golf links and a good hotel. The latter is situated on the very edge of the uplands, at a height of 4,690 feet, and affords an uninterrupted and wonderful view of the southern lowlands.

Or you may journey by Kirklees and Moon Plain, and by other routes which have but one feature in common: unlimited tea. You might think that unlimited tea connotes monotony. Not so : Ceylon is a live place : there are curious cocktails, elephants, newspapers and other purveyors of pep and banishers of boredom galore : enough for an island twenty times as big as Ceylon. A Sinhalese newspaper, for instance—now, what more could you demand for a penny, on a rainy day? You find the paper is divided into two sections, and that in each section there are three sub-sections, thus :

I Sec.—Editorials.

1. Decline of Rubber (*Depression*).
2. Increase in Income Tax (*Fury*).
3. Relief of Judgment Debtors (*Extreme pessimism*).

II Sec.—Crime Reports.

1. *Stabbings*—provided two, or more, succumb.
2. *Skids and crashes* involving—at least—the loss of three lives and total wreck of one motor vehicle.
3. *Other crimes* sufficiently ghastly to merit report.

On December 14, 1932, the Colombo correspondent of the Calcutta "Statesman" reported that Sir D. B. Jayatilaka, presiding at a village committee meeting at Ingiriya, and speaking in Sinhalese, made frequent references to the large number of murder cases reported in Ceylon. "With the exception of America and Italy, the most criminal country in the world to-day is Ceylon ; but my belief is that Ceylon will ere long in this respect beat America and Italy and take first place in the criminal world."

So perhaps Bishop Heber was justified after all.

When on trêk, Georgina and I always find that the attractions of civilization and its crowds do not endure for long. We decided to take to the road once more. Café and Noir were delighted ; they much preferred the humid heat of Colombo to the cold and wet of the hills.

On April 1, we left Nuwara Eliya for Kandy, via the Ramboda Pass.

Neuralia is 370 feet below the top of the pass, the height of which is 6,574 feet. From this elevation there is a descent of 4,900 feet, to Kandy, over a distance of 43½ miles, of which the first 23 miles are very steep and tortuous.

Kandy, with its famous Temple of the Tooth, is said to be the most beautiful town in Ceylon ; and with that description we, at any rate, agree. The lake deserves all the praises lavished on it—and so, too, does that excellent institution, the Hotel Suisse. Given the right time of the year, this would be a good place in which to spend a short holiday.

On arrival in Colombo we again stayed at the Galle Face.

While the car was laid up for minor repairs, we took to 'rickshaws as a means of locomotion, and found them both comfortable and cheap.

On the afternoon of April 4, we boarded the B.I cross-channel steamer *Chakdina*. The car had already been shipped. The whole embarkation procedure was carried out by the Ceylon A.A. in a most efficient manner, and it was not even necessary for us to look on.

At 4 p.m. we sailed for Tuticorin.

(To be continued.)

Editorial.

TUBERCULOUS BACILLÆMIA.

THE occurrence of tubercle bacilli in the circulating blood has been reported from time to time for many years, but as the bacilli have seldom been found even in severe cases of tuberculosis the subject has hitherto not aroused much interest.

Recently, however, claims have been put forward, notably by Löwenstein and his co-workers, that tubercle bacilli can be found in the blood in many varied clinical conditions. Löwenstein reports successful results, not only in pulmonary, renal, laryngeal and surgical tuberculosis, but in skin tuberculosis, acute polyarthritis and nervous diseases, including chorea, multiple sclerosis, schizophrenia and retrobulbar neuritis. In twenty-two out of twenty-seven cases of polyarthritis he obtained bacilli from the blood. In fifty-three cases of skin tuberculosis he obtained thirty-five positive results. He considers that tuberculous lesions arise in the skin not as the result of an isolated transitory bacillæmia, but during the course of a chronic bacillæmia.

These claims led to a critical investigation of the methods which have been used and to a full review of the literature of the subject by Professor G. S. Wilson and his collaborators. Numerous little known sources of error have thus been brought to light, and Professor Wilson has restated the precautions which must be observed if any reliance is to be placed on the reported discovery of the *Bacillus tuberculosis* in pathological material, and especially in the blood. Professor Wilson's report has been published on the recommendation of the Tuberculosis Committee appointed jointly by the Medical Research Council and the Agricultural Research Council.

A consideration of the results obtained by various observers employing microscopical and animal inoculation methods of demonstrating tubercle bacilli in the blood revealed such a degree of discordance that Professor Wilson found it impossible to accept them at their face value. Using the same technique contradictory results were obtained. There was no relation between the amount of blood examined in this type of case and the frequency with which acid-fast bacilli were found in the blood: there was no constant relationship between the frequency with which tubercle bacilli were demonstrated in the blood by microscopical examination and the frequency with which they were demonstrated by animal inoculation. A higher proportion was often found by microscopical examination notwithstanding that most bacteriologists consider animal inoculation the more delicate method. Acid-fast bacilli have been found in the blood of non-tuberculous persons and of apparently healthy persons.

In explanation of these contradictory results two suggestions are offered: either the acid-fast bacilli seen were artefacts and not true bacilli at all, or they were true bacilli but not tubercle bacilli. The difficulty of distinguishing acid-fast bacilli from artefacts is admitted by most bacteriologists and has led several critical observers like Kahn, Fränkel, Baemeister and Reuben to conclude that no reliance can be placed on the microscopical examination of blood for the detection of tubercle bacilli.

Admitting that the acid-fast bacilli are true bacilli it must be assumed that they have gained access to the preparations from the materials employed. In 1909 Brem made a careful examination of his reagents and found acid-fast bacilli in large numbers in the commercial distilled water supplied to his laboratory. Injection of the water into guinea-pigs showed that the organisms were non-pathogenic. When water was distilled in glass vessels previously cleaned with pure nitric acid no acid-fast bacteria were found. In 1910 Brem's results were confirmed by Burvill-Holmes who also found acid-fast bacilli in distilled water. In the same year Beitzke found that scrapings from the inside of metal taps and rubber tubes attached to them in his laboratory revealed the presence of acid-fast bacilli. These were of two kinds: one was indistinguishable from the tubercle bacillus, the other was not quite typical, and its cultures had a yellow pigmented appearance. Similar results were obtained by Schern and Dold who examined water taps in the laboratories of the Kaiserliches Gesundheitsamt in Berlin.

The possibility of acid-fast bacilli being present in tap water seems to have been overlooked for some years. In 1932, Eichbaum examined 60 water taps in Frankfurt and found acid-fast bacilli in half of them. The bacilli were very abundant in the hemp, leather and rubber washers of the water taps.

In an appendix to Professor Wilson's Report there is a detailed account by Hilda Schwabacher, one of the co-workers, of the isolation of acid-fast bacilli from water, dust and comedones. She found saprophytic acid-fast bacilli were constantly present in scrapings from cold-water taps. Hot-water taps in constant use were free from the organisms. Six different strains were recovered from water and slime, three strains from dust and one strain from a comedo. All the strains were non-pathogenic. Most of the strains grew fairly rapidly forming a confluent pigmented growth on a medium containing glycerine. Oxygen appeared to be required for the formation of pigment. The most striking difference was between rough and smooth strains. The smooth strains gave rise to a moist butyrous growth with a smooth glistening surface, while the rough strains formed a dry rather friable growth, looking not unlike bread crumbs. The smooth strains consisted of fairly long, curved, slender sometimes beaded bacilli, lying more or less parallel to one another or in bundles. Rough strains consisted of short ovoid bacilli or cocco-bacilli, arranged in a Chinese-letter form and often in dense masses. All the strains were strongly acid- and

alcohol-fast, resisting decolorization by 15 per cent H_2SO_4 for half an hour followed by methylated spirit for three minutes. All the strains grew as well at 22° C. as at 37° C. and growth occurred in ordinary nutrient broth and at some time or other on nutrient agar, though growth on agar medium was often poor.

Acid-fast bacilli may also obtain access to microscopical preparations from other sources than water. Liebermeister pointed out that Jousset's technique was open to the fallacy that most specimens of pepsin contain bacilli of various types, and the same objection applies to trypsin used by Kessler for purposes of digestion.

Professor Wilson points out that acid-fast bacilli may find their way into the cedar-wood oil used for immersion objectives unless care is taken to prevent the glass rod from touching the film; acid-fast bacilli may easily be detached from the surface of positive sputum and other preparations and be conveyed back to the oil reservoir. Baetge is stated to have found acid-fast bacilli in his cedar-wood oil and to have drawn attention to this possible fallacy.

Contamination from without cannot explain all the false positives as Liebermeister, Rumpf and Paus, who guarded against this contingency, found acid-fast bacilli in a high proportion of bloods examined. These workers used the Stäubli-Schnitter anti-formin technique which is stated to give rise to confusing artefacts.

The recorded results obtained by animal inoculation of blood from cases of supposed tuberculosis cannot be accepted uncritically. Professor Wilson states that there is almost as much discrepancy between the findings of those workers who have employed an animal inoculation test as between the findings of those workers who have relied on a microscopical examination of the blood. The reasons for these discrepancies are to be found in the entirely different criteria used by different workers in diagnosing inoculation tuberculosis in the guinea-pig. A great many workers seem to have little idea of the appearances presented by the disease and are incapable of differentiating it from a number of other conditions with which it might be confused. Some workers have diagnosed tuberculosis in the complete absence of macroscopic lesions and have relied on either a positive tuberculin reaction or on the finding of acid-fast bacilli in the blood. To regard a rise of temperature to over 39° C. after the subcutaneous injection of old tuberculin, or a local reaction following the intracutaneous injection of a 20 per cent. solution of old tuberculin, as diagnostic of tuberculosis, in spite of the fact that the animal at post-mortem examination shows no evidence of disease, is clearly unjustifiable.

Professor Wilson states that to use the guinea-pig as a simple *in vivo* culture medium as several workers have done, and to rely on the demonstration of acid-fast bacilli in the blood or organs, in the complete absence of macroscopic lesions, is not only a travesty of the whole method, but affords no evidence of the presence of virulent tubercle bacilli in the original

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material. He considers that one of the most important errors responsible for the conflicting results obtained is that many observers have failed to differentiate inoculation tuberculosis from spontaneous tuberculosis, and from other diseases such as pseudo-tuberculosis, Salmonella and *Brucella* infections, which give rise to lesions superficially resembling those of tuberculosis. Délepine, as long ago as 1909, pointed out the characteristic lesions produced after subcutaneous inoculation into the thigh of the guinea-pig.

Enlargement of the mesenteric glands after intraperitoneal inoculation has been regarded as diagnostic of inoculation tuberculosis. The introduction of tubercle bacilli into the peritoneal cavity is followed by enlargement and caseation of the pyloric, sternal, and cœliac glands with subsequent affection of the retroperitoneal glands. The mesenteric glands either remain unaffected or become enlarged, and caseous in the cortices only, as a result of intestinal tuberculosis occurring in advanced generalized disease. On the other hand the mesenteric glands are generally enlarged in spontaneous tuberculosis and in pseudo-tuberculosis of alimentary origin. Pseudo-tuberculosis is a common natural disease of guinea-pigs, which may crop up sporadically and deceive workers who are not familiar with the appearances produced.

It is absolutely necessary to put up cultures on ordinary media from doubtful lesions to exclude the presence of such organisms as *Bact. pseudo-tuberculosis*, *Bact. aertrycke*, *Bact. enteritidis*, and common saprophytic acid-fast bacteria.

A critical examination of the figures obtained by the animal inoculation method rendered it probable that genuine tubercle bacilli have been demonstrated in the blood in about 4·9 per cent. of patients with severe pulmonary tuberculosis, in about 36·4 per cent. of patients with miliary or meningeal tuberculosis, and in about 2·7 per cent. of patients with non-pulmonary tuberculosis.

Professor Wilson concludes that "tuberculous bacillæmia, except as a sporadic phenomenon, is uncommon except in patients suffering from advanced or progressive disease."

The methods of cultivating tubercle bacilli from the blood used by Löwenstein and his pupils are discussed at length. The main purpose of the technique is to remove from the red cells the whole of the hæmoglobin, which Löwenstein regards as unfavourable to the growth of tubercle bacilli. Some years ago Löwenstein came to the conclusion that peptone was not conducive to the growth of the tubercle bacillus. He therefore prepared his own medium in which peptone is replaced by asparagin as a source of nitrogen. In 1932 he further modified the medium, which should be used fresh. The medium has been found to be an excellent one for the primary isolation and growth of the tubercle bacillus and is now used in some laboratories as a routine medium for this purpose.

The results obtained by workers who have examined blood both by

culture and by guinea-pig inoculation are in almost complete disagreement with Löwenstein's cultural results. Only in cases of severe pulmonary or generalized tuberculosis have these workers been able to demonstrate the existence of a tuberculous bacillæmia, and then in only a very small proportion of cases. Many of the negative results are reported by workers who have previously visited Löwenstein's laboratory and studied his technique. The failures, therefore, cannot be attributed to technical imperfections.

Professor Wilson after a careful study of all the available information concludes that Löwenstein's failure to give adequate figures and protocols, his reliance on imperfect methods of identification, and his neglect to make the thorough study of all cultures which alone can entitle him to pronounce on the presence of the tubercle bacillus in the original blood, so invalidate his conclusions that their unqualified reception by scientific workers cannot be seriously entertained.

Clinical and other Notes.

AN OBSCURE LUNG CASE.

By Major D. C. G. BALLINGALL, *M.C.*,
Royal Army Medical Corps.

The following case in a healthy young soldier caused considerable difficulty in diagnosis :—

On June 10, 1931, Private W. S., aged 24, service six years, a healthy-looking well-built man, teetotal and non-smoker, reported sick and was detained at the Camp Hospital, Shanhaikuan, China, with sudden onset of malaise, pains in upper part of the left chest and pyrexia. There were no physical signs.

The fever persisted, and he had a series of hæmoptyses. On June 12 he was transferred to the British Military Hospital, Tientsin, where the case was diagnosed as left (lobar) pneumonia.

He was a Londoner, had been a shop assistant, and had had no serious illnesses.

On July 2 a radiogram of the chest showed the apex of the left lung to be hazy and a rounded shadow in the upper part of the hilum. The right lung was normal.

On July 4 he was transferred to Shanhaikuan Seaside Camp for convalescence.

On July 12 he started a "riding sore" on the right shin, which healed in one week, but left a large, tender, hard lump in the right groin (inguinal gland). With this he "hung about the Camp Hospital" for six weeks until he volunteered for duty with his company, which had returned to Tientsin.

On October 3 he was re-admitted to the British Military Hospital, Tientsin, with irregular, daily, intermittent fever, temperature 103° F. and pains in left chest and back, headache and "feeling bad all over." Pulse 72 to 80 per minute; respiration normal. No definite physical signs could be found. The temperature apparently responded at once to quinine, although repeated unsuccessful search was made for malaria parasites.

On October 7 a radiogram of the chest indicated that: (i) the apex of the left lung had cleared up; (ii) the shadow seen at the upper part of the left apex had become much larger and more dense and could not be explained. The persistence of an upward cone-shaped protuberance of the right cupola of the diaphragm suggested the presence of a liver abscess (no cysts were found on repeated examination of the stools, and the temperature suddenly and permanently dropped to normal on this date; emetine therefore was not given).

The right inguinal lymph gland was still large and hard, and on

October 19 he was discharged to duty and observation with a diagnosis of anæmia, the temperature and pulse having been normal for twelve days.

On October 23, he was admitted for the third time, looking ill, with a short cough (M.O. reports a "rub" just below the heart). Pulse 110; respiration 30; temperature 103° F., and hectic in type. Physical signs indefinite. Repeated examination of the scanty sputum failed to show tubercle bacilli.

Blood examination showed red corpuscles, 5,200,000; hæmoglobin, 80 per cent; white corpuscles, 10,000. Differential count: Normal except for polymorphonuclear leucocytosis.

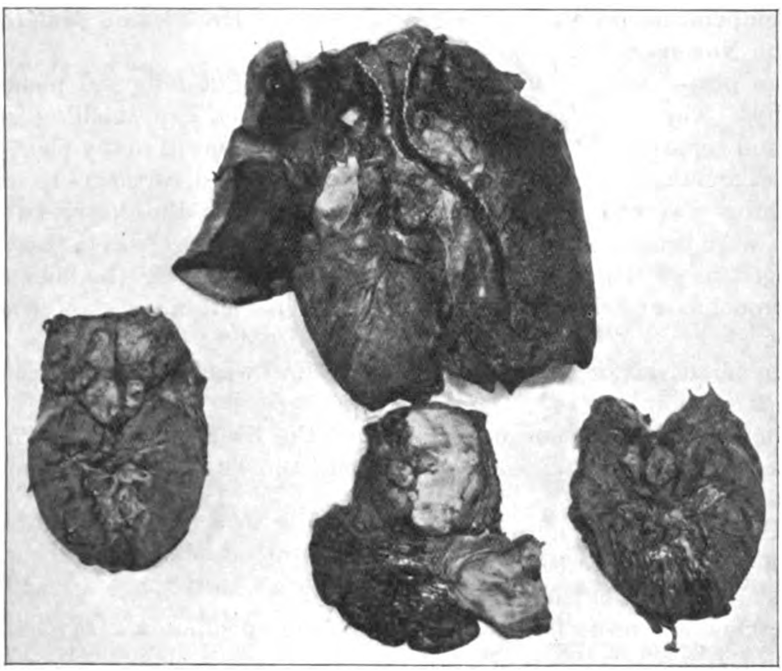


FIG. 1.—Photograph of lungs, heart, kidneys and suprarenals.

Wassermann reaction positive. Patient frankly denies possibility of venereal disease. Congenital syphilis of the left lung, mooted as a diagnosis. Right inguinal lymph gland was gristly hard, irregular, not inflamed or fixed, and the size of a bantams' egg. Left supraclavicular gland was enlarged and hard. The possibility of lymphosarcoma was considered.

On October 27, a radiogram showed left pleural effusion.

On November 1, a second radiogram showed almost complete opacity of the left side of the chest. The right inguinal gland was dissected out under a local anæsthetic and cut in half. The capsule appeared to be intact and the cut surface was firm, homogeneous and pinkish in colour. One

half was sent to the China Command Laboratory, Hong Kong, and the other to the Peiping (Peking) Union Medical College. The physical signs in the left lung suggested hydro-pneumothorax, and the patient complained of "rumbling" in the chest on turning in bed, indeed this could be heard two yards away! but aspiration proved abortive, only a little air being withdrawn.

Active anti-syphilitic treatment was given in the hope that the condition was specific in nature, but the arrival of reports on the lymph gland on November 14 proved it to be malignant. From this time the patient rapidly lost condition on account of toxæmia, dyspnœa and severe pains in the chest for which he had to be kept under the influence of narcotics. His temperature dropped from 104° to 96° F. He became comatose, and died on November 22.

The post-mortem examination showed the right lung and pleura to be healthy. The left pleural cavity contained much evil smelling grumous fluid and some gas — ? air. The pleura was adherent in many places to the parietes and the basal pleura was thickened into hard, cartilage-like nodules. The lung was collapsed (atelectasis), particularly the lower two-thirds which were bronchiectatic and pregangrenous. There was a hard white homogenous growth the size of a cricket ball involving the lumen of the left bronchus and infiltrating the lung. The left apex showed a small cavity.

The heart was normal, but the pericardium was filled with clear blood-stained effusion.

The abdomen was normal except that the liver was large. The right suprarenal gland contained a large, and the left a smaller, metastatic growth.

Other glands were normal.

The points of interest in this case are :—

(1) The youth of the patient (24 years).
(2) Sudden onset of symptoms resembling pneumonia *with hæmoptyses.*
(3) Early involvement of a right inguinal lymph gland.
(4) Hydro-pneumothorax.

Report on Enlarged Right Inguinal Gland from the Peiping Union Medical College.

The histological picture somewhat resembles that of the so-called "lympho-epithelioma" described by Ewing, which arises from the modified epithelium overlying the lymphoid structures of the nasopharynx and produces early metastasis to the neck.

The presence of some collagen fibres in between the cells is a feature not seen in carcinoma. But, owing to the general alveolar arrangement of the tumour cells and many areas not showing any intercellular matrix, the diagnosis of carcinoma is more likely than sarcoma.

Report on Hard White Growth from Hilum of Left Lung, and on a Large Growth from Right Suprarenal Gland.

Microscopic Examination of growth from left lung. Section shows irregular masses of dark staining oval or polygonal epithelial cells showing frequent mitoses and growing in an infiltrative fashion. Between the masses are thick bands of hyalinized fibrous tissue stroma. There are many areas of extensive necrosis. Lung tissue and bronchioles are present at corners of the section. Section of the growth from suprarenal gland shows a similar tumour, in the stroma of which cells of the adrenal gland are found. Also adrenal tissue is found at one corner of the section.

Diagnosis.—(*a*) Carcinoma in lung (arising from bronchial epithelium). (*b*) Metastatic carcinoma in adrenal gland.

Report from the Command Laboratory, Hong Kong, November 2, 1931, on the Enlarged Right Inguinal Lymph Gland, by Dr. A. V. Greaves, Government Pathologist, Hong Kong.

I do not feel at all certain as to the origin of these cells in the lymph gland. I do not think they are of lymphoid origin—they rather suggest metastasis from an outside focus. There is hardly any doubt as to their malignancy; mitoses are particularly numerous and the manner of growth quite typical.

It is tempting to suggest sarcoma, but the clinical history is rather against a simultaneous growth and inguinal nodes. The most I feel justified in saying is that the section is malignant tissue, probably sarcomatous.

Further Comments by Dr. A. V. Greaves of Hong Kong after Examination of Additional Materials.

Sections of the tumour proper show it to be composed of masses of dark staining cells with large vesicular nuclei; the individual cells being very undifferentiated. Mitoses are numerous. The manner of growth appears to be as strands or columns of cells; the anatomical arrangement, however, in many places shows definite evidence of an attempt at alveolar formation and the carcinomatous structure is plain. In one of the glandular metastases there is some suggestion of collagen fibrils between the cells, but I do not feel quite satisfied about this and it is doubtful to say the least. The metastases show extreme metaplasia and here the likeness to sarcoma is strong. In some areas the histological picture resembles the type described by Adler as medullary carcinoma. As is usual in broncho-pulmonary neoplasms the advanced state found at necropsy makes difficult an exact diagnosis on a histological basis alone, but in this case the excellent pathological preparation pictured leaves no doubt of the close and definite relation to the bronchial tree, and the gross evidence together with the microscopic makes it possible to place the tumour as a carcinoma arising from the bronchial epithelium. Careful search of the sections reveals areas in which the columnar character of the cells can just

be made out and there is also to be seen definite evidence of attempts to line cavities with columnar cells in palisade formation. It is unfortunate that none of the sections shows any of the larger bronchi with which one could attempt to orient the neoplasm. The lung alveoli adjacent to the mass are alternately collapsed and dilated and many of them are filled with tumour masses, producing irregularly distributed areas of neoplastic pneumonia.

One very interesting feature is the comparatively early metastasis to the inguinal lymph nodes, hardly one month after the first complaint and admission to hospital. At this period of the illness extension must have already taken place along the thoracic duct to the deep glands of the upper abdomen, thence along the vertebral chain of lymphatics to the deep

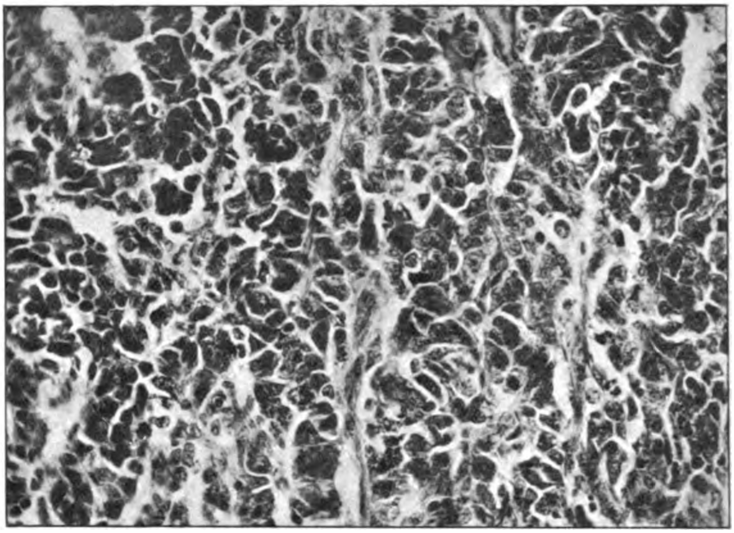


FIG. 2.—Tumour in lung (× 295).

glands of the lower abdomen and thence to the inguinal. The adrenals were probably not involved until a much later stage of the process, as debility was not a prominent feature until about three months later. Among the widely distributed sites subject to metastatic invasion the skin is numbered 4 per cent. in Rogers' series; and one cannot help wondering whether the so-called "riding sore" which developed coincidentally with the inguinal adenopathy may not really have been a skin metastasis, although the fact that it apparently healed would weigh against it being so. The liver in this case appears to have escaped invasion, which is decidedly unusual; in Adler's series it was involved in 27·5 per cent.; the smaller series recently studied by Rogers showed metastasis in 34 per cent. The latter observer also comments on the frequency of metastasis to the adrenals. Alder gives 14 per cent and 15 per cent as the frequency of involvement of brain and

bones respectively, while Rogers gives 20 per cent and 38 per cent for the same tissues. Here both brain and skeletal tissues seem to have escaped. The absence of metastasis to liver, brain and bone is a noteworthy feature.

My thanks are due to the Department of Pathology, Peiping Union Medical College and to Dr. A. V. Greaves, of Hong Kong, for reports on tissues.

Also to Lieutenant-Colonel H. P. Hart, M.C., R.A.M.C., O.C., British Military Hospital, Tientsin, for permission to send these notes for publication.

TWO SUGGESTIONS FROM A LABORATORY IN INDIA.

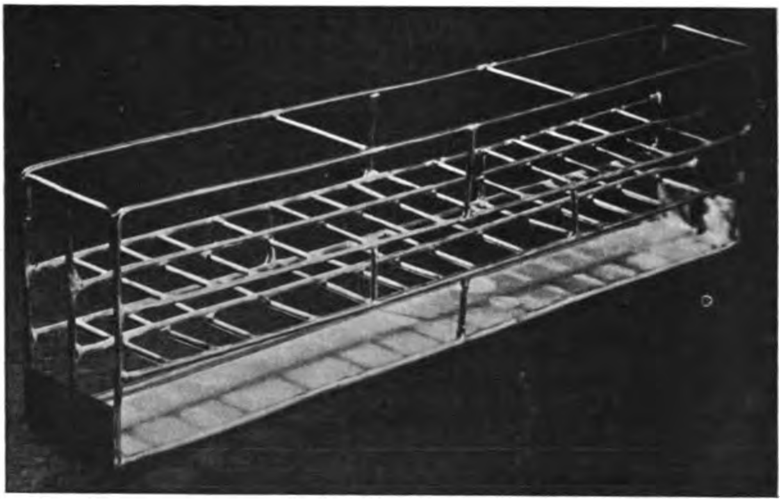
By Major D. T. M. LARGE,
Royal Army Medical Corps.

The following two suggestions are handed on to those interested in laboratories and disease prevention, in spite of the fact that they may be regarded by those who are not so interested as the work of a crank. The first if adopted would save a good deal of money in incubators, and the second much disease. Both save trouble, and have been found of service.

(1) Incubator Space.

It has always been a matter of surprise to me that incubator makers do not provide several alternative means of accommodating culture tubes, etc., so that the greatest possible use may be made of the space available. They get over the difficulty of suiting everybody by providing no means at all, with the result that incubators are as a rule thoughtlessly packed, space is wasted, and demands are made for more incubators. This doubtless suits the incubator makers, but the difficulty may frequently be got over at an expense infinitesimal when compared with that of getting an extra incubator from the makers in England. Until recently, sets of sugars were incubated by me in ordinary round cigarette tins placed side by side on the incubator shelves, and the waste of space was such that only thirty-two tins could be fitted into the ordinary small Hearson incubator used in military laboratories, and in addition considerable time was lost in arranging the tubes of each set for ready observation. Recently a sugar-tube rack was devised with the help of Lieutenant-Colonel G. R. Lynn, D.S.O., I.M.S., in order to avoid waste of time in arranging the various "sugar tubes" when dealing with large numbers of intestinal organisms, and to economize incubator space. By its use the sugar tubes are kept in the incubator in any desired order ready for inspection, and the rack has only to be taken out of the incubator, inspected, and returned for further incubation without the troublesome necessity of having to arrange each tube separately day by day. The racks are made to fit the incubator, and in the small Hearson there is room for twelve racks, giving accommodation for seventy-two organisms, each put up in

glucose, lactose, mannite, peptone water and broth, and each set separated by a special crossbar. This crossbar marks off a compartment on each side for five tubes, and there are three such compartments on each side of the rack, *vide* illustration. Each rack consists of a tin base with wire uprights, and it can be made by any tinsmith for one rupee. For the incubator above mentioned the length of each rack is 11 inches by 1⅞ inches wide and 3 inches high. A strip of cleaned X-ray film is attached to each side of the rack, on which particulars of each organism may be entered with a grease pencil. This can be used again and again as the marks are easily removed with xylol.



SUGAR-TUBE RACK.

For a single incubator, six racks are required, which fill the bottom of the incubator completely, leaving a shelf for plates, odd tubes, etc. In order to make the best use of this space, special tins 3½ inches square can be obtained from a tinsmith for four annas per tin, and it will be found that these fit in side by side with stacked rows of 4-inch plates, so that all available space is utilized.

(2) GRAPH COMPARATOR.

This is devised to simplify the reading of a complicated series of curves recording the incidence of various diseases and their possible causes. For example, a chart showing the weekly incidence of dysentery, diarrhœa, sore throat, etc., with their relation to atmospheric dust, temperature, humidity, rainfall, number of flies, etc., would be impossible to read easily. By using the comparator described herewith, however, the relation between any two or more of these can readily be estimated.

The graphs are made on cleaned X-ray films with ink or grease pencil,

using one film for each disease and one or two for climatic and atmospheric conditions, e.g., a standard size for each chart is adopted. The base and side lines are traced from the original standard chart, and once begun it is as simple to make the weekly entry on the separate films as on one chart. The films are fitted into slots in the uprights of a frame, and can be conveniently kept in the frame if six or seven slots are provided, the whole being excluded from dust by a lid on the top. To compare the incidence of say pharyngitis and atmospheric dust, one removes all other films from the frame, and examines by transmitted light.

Old X-ray films cost us nothing, and are easily cleaned by dipping in hot water, and removing the sensitized portion with soft cotton-wool. The frame costs two rupees.

If desired, more permanent records may be made by using glass-writing ink made by adding tinct. benzoin. co. to any laboratory stain.

Travel.

BEYOND LEH.

A SHOOTING TRIP IN LADAKH, 1926.

Being a Diary kept by
K. W. DICKSON, F.R.G.S.

(*Continued from p.* 309.)

XIII.—A Great Day's Sport.

I had been thinking of starting up the opposite valley with the gun (there were chikor about and our food supplies were very low), when R. arrived back. I was so glad I had not gone out. He had his legs massaged and drank pots of lemon tea while I heard all about the day. They had climbed all morning and had seen two small herds far away, one herd of five and the other of about seven animals. They decided to do a long detour to get nearer to the far herd to see with the telescope if there were any good heads. Suddenly there appeared from below still another herd of three ewes and two big rams. R. and the three men were clambering among rocks and looking down on them; luckily the wind was blowing up and not down. The local shikari spotted them at once, motioned to R. to drop, and R. had to whistle to Khazir But, who was some distance ahead; the animals were within easy range. The biggest one was shot first and never moved, shot through the heart. This of course did not prevent the tiffin coolie from rushing down and cutting its throat to make it fit food for the true Mussulman. The law of Islam forbids the eating of flesh or fowl killed in any other way; fish they say has already been prepared by Allah, having a slit at the gills.

The rest of the herd made off at full gallop, making a wide detour to a side nullah. R. thought he saw where they were making for, and ran across by a short cut and got within about 200 yards. The first shot the shikari said missed, but the animal stopped, so R. fired again, this time through the heart. When it was all over, Khazir But grasped R.'s hand and shook it warmly; R. was very amused. He went to see the first burrhel skinned, so did not see whether he had really missed the galloping animal. They were shot about 1 o'clock, eight hours after R. started the climb, and he was back with me by ten minutes to three.

There was great excitement in camp. A shikari always has a tape measure in his pocket to measure the horns. As he appeared, R. called out

FIG. 13.—Burrhel heads at Tangyam.

"Kitna?" (how much). "Twenty-seven and three-quarters, Sahib; big head, big head." The other was smaller, but had beautifully shaped horns. They looked to me, when they were brought in, like deer with great rams' horns. We took a photograph after they were brought to camp. Kelpie was greatly excited, and Garry had to be tied up. Soon the servants, in fact the whole camp, were busy cutting up meat. A leg was kept for us, and also the liver and kidneys. The rest was divided among servants, and the local shikari seemed to have assisted, for later in the evening he passed along the fields above, his long woollen coat covered with blood.

We had liver and bacon for breakfast next morning, a fine dish. The dogs had their share of the meat; they had had nothing but chuppatties (country meal cakes) and soup for at least a fortnight.

We spent a lazy Sunday morning sitting on some turf about a mile up the stream, where R. went the day before. He wanted a rest after such a strenuous day. We saw some birds which the shikari calls ram chikor; they are large fowl, rather like little turkeys, with a spreading tail.

There was snow by the stream half a dozen yards from where we were sitting, but the sun was warm and pleasant. We had a real Sunday tiffin that day, with a kind of haggis made from the burrhel's liver; Khansamah played up well. The yak's milk was delicious at Tangyam; if we had been staying longer I would have made butter, the cream was so good.

In spite of a great deal of noise in the fields round about, we slept soundly that afternoon.

FIG. 14.—Camp on Tangyam. Winter supply of fuel on the tops of the houses.

For ploughing and sowing the whole village turned out, men, women and children, yaks, ponies, sheep and goats, all seemed to be in the same field. One man leads a pair of yaks, enormous powerful animals they were; another guides the plough, singing lustily a chant with a chorus in which they all join, and accompanied by a kind of tin whistle which is not shrill; a youth plays this, while a woman beats a drum. In the distance it sounds not unlike bagpipes.

These Ladakhis are the cheeriest people I have ever seen. One hears about a hard climate making a people dour and sour, but these little folk are the very opposite, so willing to help, and not expecting an undue amount of backsheesh. The little man who carried the provision sack up from the lower camp fell down in a bed of broken granite; he made no fuss

at all, and was up at once, looking at me and laughing, as if the fall down were a huge joke. Their long woollen cloaks are awkward to walk in.

It was a great experience to me to see how they trusted a sahib so absolutely. While in Tangyam we got milk and wood, and transport was supplied. We were there six days, but paid nothing until the day we left. It says a great deal for the sahibs who have been there before, that the people have never been let down.

XIV.—The March to Niss.

We were sorry to leave our cheery crowd of villagers next morning, but many of them seemed to come with us, as we had eight yaks, and at least eight men looking after them.

The road after reaching the Indus was much the worst we had seen so far. We were following the river when the path abruptly turned up the cliff side, 400 feet at least up a zig-zag staircase, wonderfully made, about thirty rough steps at a time, then a steep slope, then steps again. A sudden descent of 200 yards brought us to the river again.

Garry was very bobbery after his rest in camp and went off after marmots. We lost him absolutely for an hour, but Khazir But brought him along behind.

Gaik is a tiny cultivated patch at the foot of a gully, sheer on the Indus banks. The descent to it was worth a photograph, but unfortunately the sun was not shining. We were both very tired, after so much climbing, I suppose. We had chikor for dinner as the burrhel was still "sukhet" (tough) the khansamah said.

Quite unexpectedly Chota Subhana arrived from Leh with our mail, lots of letters, the *Sunday Observer* and the *New York Times*. It was very cheery getting letters again.

I woke very early and did not sleep again, and felt very cross and irritable all morning. Breakfast was a hurried meal, and we started about 6 o'clock on the road. The map was misleading as to nullahs and distances, and R. was not sure how far we had come. The Kashmiri boy would keep walking on my heels. I glowered at him several times, but managed not to say what was on the tip of my tongue.

Another winding staircase, then on the top of precipices most of the way. My pony was pretty sure-footed and well behaved when I was in the saddle, although he danced about when other ponies passed. Its owner was the cheeriest little fellow, so thoughtful on my behalf, looking out for overhanging rocks, and seizing the pony's reins to lead it away from them, so that I shouldn't hit my head.

We met a sahib down by the river, coming in the opposite direction; his nullah was further up the Indus. He had finished his shoot and was returning. R. talked to him for a few minutes, but Mahamdoo again stood directly on R.'s heels, listening to all that was said with open mouth, so that I could hear nothing of the conversation. In a country where

travellers are few and far between, one naturally wants to hear all the news.

A long weary road in soft shale, then a fine purple hill ahead, a white house and some chortens shining in the sun: this was Kiarie. A steep descent down a path all mulberry-coloured shale, and we were there. Here we had to halt to change ponies, so although it was early, we got the tiffin basket and found a sheltered place under the mulberry cliffs, where the wind was not too penetrating.

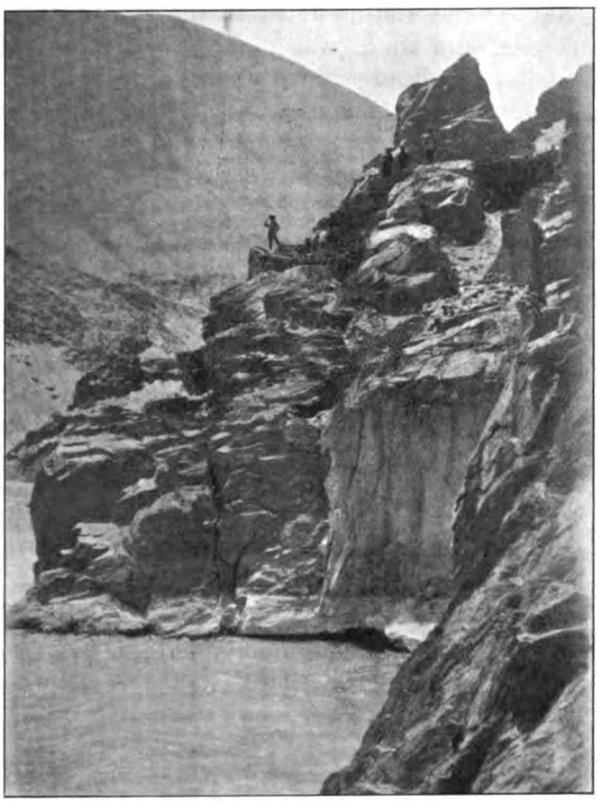


FIG. 15.—Path near Kiarie.

Kiarie is a pretty spot, much opener than Gaik, and the colouring of the hills around almost beats a heather moor in August sunshine—I said "almost." We were rather tired to have much appetite, so had cocoa, cheese and jam.

The Kiarie ponies were soon loaded up, and our Kiamjun friends paid off, and they went back to their own valley. I got a new pony, a tiny white one, rather difficult to approach, but it seemed all right once I got on. It was a "butcha" (young thing), the man said, just three years old, and

from the feeling of its back, I don't think it had been saddled very often. I walked up and down the most precipitous parts of the road for the rest of the journey.

An hour after lunch, as we were sitting for our usual ten minutes' rest by the roadside, I saw something move on the top of the cliffs opposite, five or six hundred yards away. It was a young burrhel, with its mother standing quite near. We called for the glasses and watched through them. In a few minutes one after another appeared over the top of a rise much lower down. They made a good deal of noise in the perfect stillness, as their feet sent loose stones rolling down to the river below. One by one they topped the rise, and there was great excitement when two rams appeared, one a fair-sized head. Turn about we watched them through the glasses, and counted fourteen or fifteen. The two above joined the herd with a great rattle of falling stones. The wind was blowing from them towards us, and although they seemed to watch us occasionally, they had no fear. We made the dogs lie quiet, and crawled forward to the edge of the cliff on our side of the river. Gradually the whole herd came down like a flock of sheep to the water just below us. We peered over the cliff to see a long line of sixteen heads bent down, all drinking at the same time. R. crept forward to get a photograph which I hoped would enlarge, but the sun was unfortunately behind a cloud at the time. The young ones were the last to leave the river, a ewe waiting behind to see them safely up the hill. The two rams had a fight, and chased two of the young ones up some perpendicular cliffs. They leapt like hinds from one tiny ledge to another: it was marvellous! We held our breath, and Garry sat up to watch this strange sight. R. said it was much more interesting than when he was stalking the burrhel he shot.

We spent nearly an hour watching them, and then went on our way across more wine-coloured cliffs and over a plateau where the hills came down in wonderful streaks of ochre, mulberry and green, as if a giant brush had tried to blend the colours. The path twisted round another of those ruins perched on a rock, and then across a stream and up to the village of Niss.

We arrived to find the tents in a tiny paddock enclosed in mud and stone walls with two big chortens just behind. We had tea as soon as a kettle could be persuaded to boil. Green willow twigs seem to be the only form of wood to be had here. I told khansamah that we were lucky to have had wood so often to burn, as the guide book says wood is scarce in Ladakh, and that scrub and furze bushes are often all that is obtainable.

There were hundreds of pigeon about, so we took out the gun and I got one, and R. got four with one cartridge. We had to shoot them sitting, as by that time we were very short of cartridges for the gun, and in great need of flesh for the pot.

XV.—Chumatang, the End of our Block.

About our usual time, somewhere round about 6 o'clock, we started off for Chumatang, a march of fourteen miles. A lovely clear cold morning; the path lay across an open moor; there was nothing growing on it, but the mulberry shale gave it an attractive look. We soon got down to the river again and saw a few duck, but too far away. The day before, as we came round the corner of a very precipitous path well up the side of the hill, we met quite a flock of sheep and small goats; most of the goats were

Fig. 16.—Chumatang in the distance, 130 miles beyond Leh.

white, and very small, with fine hair. A tiny girl of 7 or 8 was herding them back to Kiarie. She was quite composed until the dogs appeared, but on seeing them she burst into tears, and rushed past us, darting under the pony's legs. R. had been keeping Garry and Kelpie well in hand on account of the goats, but one kid was so afraid of the dogs that it got behind, and we had to catch it and give it to the little girl. We tried to comfort her, but she ran sobbing down the hill, with the little kid hugged close to her breast. In most of the villages the people were very afraid of the dogs although Garry and Kelpie paid no attention to them.

I had the same pony to go on to Chumatang. It was very lazy, and the owner told the tiffin coolie to hit it behind. It bucked and bucked, and at last sent me right over its head, and the man sprawling on the ground. Luckily the ground was sandy, and I was hardly stiff from the fall, only a few bruises on my legs from kicks. The pony was not shod, which again was very lucky for me. If I had been lamed by a kick, my transport would have been a problem in such country.

We walked on up hill for some time after this, and then came to a soft patch by the river again. There were still a good many miles ahead of us, so we thought I might try the pony on safe ground, but it would hardly allow the man to adjust the saddle, and kicked when I went near it, so we decided it was best for me to walk. We climbed up another hill, and came into full view of Chumatang in sunshine, at the end of a long valley, with great brown hills striped like a tiger's back rising up behind and beyond great white snows, one peak rising to twenty-one thousand odd feet. It was the best view we had had, and was well worth a photograph.

We slept for half an hour after tiffin, lying in the sun at the top of the hill. Garry and Kelpie had great runs that day, the country was so open, and they lay panting in the sun while we had tiffin. There had been a bridge of four or five spans across the Indus here, but it was all broken down, only the stone piers left, and even parts of these had been swept away by the current.

We were glad to feel that night we were near the end of our outward journey. Khansamah was looking very tired, and little Jit Ram was needing a rest too. We had heard so much about servants being a nuisance and always grumbling on trek, but both of ours were splendid; never a grouse even in the worst weather, and sometimes I was horribly irritable when things were not quite right—so much so, that I wondered they stayed with me. I would have given them both full marks on that trek. The cold seemed to muddle Jit Ram's brain, for he never seemed to know which were my belongings and which were R.'s. It would have been a blessing to have had a man who put the same thing in the same place every day.

That day the Kashmiri boy had again walked just behind us; his frequent and noisy expectoration was too much for me. I told him to keep further behind, and that he must not behave like that before me. Then I felt I had been rather harsh; he was only 18, but he had to learn the ways of sahib log sometime.

No parasites found for three whole days! I hoped we were getting rid of them now. I must inquire from some of our doctor friends at the Central Research Institute, when we get back to Kasauli, about the life history of this variety. Fleas are gentlemen enough not to inflict you with their nurseries, but these—enough said! I had put garments in a strong solution of perchloride of mercury. R. says I am not a good campaigner, objecting to little things like that.

Unfortunately R. was feeling sick and generally seedy next morning, so

there was no question of going up the nullah. I think even the shikari was glad of a day's grace ; certainly the servants were delighted.

R. had caught a chill when stalking at Tungyam. He had taken no overcoat with him, and they lay amongst the rocks for several hours. The sun had been shining, but at an altitude over seventeen thousand feet it isn't warm in early May. He slept most of the morning however. I found I had a bottle of the forbidden Bovril, which I had brought into Kashmir unawares. Kashmir is a Hindu state, and the cow being the sacred animal of the Hindus, the slaughter of cows is a dreadful crime, and the import of any form of beef is prohibited. I did not know this until we were in Srinagar. R. found the Bovril more palatable than anything else.

Not having a comfortable chair, I sat on the saddle pad propped up against the camp stool set on its side, which made a good back rest. I darned socks and read the *Observer*. These roads were very hard on socks.

The sun shone all morning, and it was delightfully warm. R. got up for tea, and we had it outside; then he suggested a stroll up the river. We called for the gun and started off. He got three pigeon straight away, then we climbed down to the path by the river. I took the gun and wandered about, seeing several duck, but all on the far side of the river, so that even if I had shot one, we would not have been able to retrieve it. It was a perfect afternoon, and we probably were both feeling the benefit of the morning's rest, as we agreed it was the nicest stroll we had had. The sun was warm and the sky blue, with great fleecy clouds blowing about.

The Tehsildar (a magistrate) of Leh was doing a tour of the district, and arrived in Chumatang while we were down by the river. R. had a talk with him while I was having my bath. He was a good class Hindu, and had been at Leh for a year and a half. When not hearing evidence or sitting on cases, he was studying for the examination for a second-class magistrate, and had a book in his hand when R. met him. He told us he had been in Jummu for some years, but his family had never been well there, and he liked Leh much better. He had "about six children," he said, "a new one every other year." He travelled in great style with a great white E.P. tent with a verandah attached ; our little eighty pounders looked tiny beside his. He had his own ponies, and one looked a particularly nice one, with a good English saddle. It was both fast and sure-footed—the latter being essential on these paths. He gave orders to the lumbadar (the head man of the village) to send us milk daily when we went up the nullah. It was not sent, but later when I saw the road, I did not wonder. He gave R. a letter to his Deputy in the Game Preservation Department in Leh about getting a sharpu, should R. not get one in his own block. Number sixteen was registered as a sharpu block, but the people of the district said there were few, if any, in that part of the country, so it looked as if we would have to go back to Leh without one. Round Leh there are open nullahs, which means that anyone who already had a licence could, on obtaining permission, shoot there without further payment ; this was at least cheering news.

R. went straight to bed when we came in, and we dined in the sleeping tent that night. Khazir But came for orders, and we said chota hazri at half past five, and on the road by the usual time, if the sahib slept well; so tea was brought at 5.30 next morning. On waking I felt as if I had been beaten; I had probably got a chill, and I was very conscious of the places where the pony had kicked me two days before. However, it was, as we thought, a very short easy march about seven miles up the nullah, and it seemed better to get to our destination, as we had already lost a day. A little brown pony was brought for me, but it was the worst we had ever had. It placed its feet anywhere on loose stones, and stumbled every third step. We left at 7.15, and it took us more than six hours to do these seven or eight miles. As Jit Ram put it, "ye subse kharib rasta hai"—the worst road of all. One could not call it a road. Our aim was a more open part of the valley further up, and we climbed and climbed, a piercing wind blowing, then a snowstorm descended upon us. For about an hour I looked in vain for a sheltered place where we could sit and have cups of coffee. At last we got behind a few stones which had been put together for the protection of animals. The place was rather odorous, but anything was better than that wind.

R. had been walking on the other side of the gully with the gun, and had shot two ram chikor; he also saw two big hares. We were both very tired and weary, and we sank exhausted among the stones and drank our coffee while the snow fell. Garry and Kelpie had been off hunting for some time, and Kelpie came back first; then I heard a noise like the howling of a pack of wolves in the distance. What it was I do not know, but I got up hurriedly to look for Garry, when he appeared over the next rise. Here we let the servants and yaks pass, and followed on a little later. There were no habitations of man up that gully, so there was no possible shelter until the tents were pitched, and no point in our going ahead of the baggage. The whole way the stream and its banks were covered with snow; sometimes a part of the stream was in sight, sometimes we only heard it. The path wound from side to side crossing snow bridges. I saw a few ram chikor, but otherwise only the usual magpies and crows which were everywhere.

We were almost exhausted when we reached our camping ground. It is difficult marching when one isn't fit. The servants had been very quick, and even our beds were made up. I really felt too tired to sit up while the men rubbed my legs; the precious aspirin bottle was handy, and I lay down. The ground was very uneven, just a few tufts of grass on an island of rock. Deep snow lay quite near, and the stream seemed to be on both sides of us, only two yards away from the tent, but far underground. I really think the water flowed underneath us too, but towards evening all was quiet; I understood next morning the silence when I saw the frozen stream. I went to bed before dinner. If the weather was fine, the plan was that R. would go further up early next morning, looking out for tracks of Ovisammon.

If I had not kept a diary, I do not think we would have remembered the days of the week. We would have been almost as bad as Ben Gunn when he thought a Sunday was about due, and he went and sat amongst the bones. The Mani walls would have done for us. I sometimes thought that an old-fashioned Sabbath rest would have been a good idea on the march, then I would have been sure of one day's rest in seven, but our leave was limited; we had far to go; and we had many enforced rests on account of weather.

It seemed to snow half the night, and it was bitterly cold. We wore as many clothes as it was possible to sleep in. I wore at least six thick garments, and all the coats and waterproofs were piled on the bed, but that wind of Ladakh pierces every cranny, and a tent is not airtight.

The ground was white and it was still snowing when our morning tea was brought. The weather was thick all round and we could see only a few yards ahead. Such weather was no use for shikar, so we turned over and tried to go to sleep again; even the dogs did not stir. R. dressed and we had breakfast about seven, the last of our precious bacon; somehow it did not seem quite so good as usual. More snow fell after breakfast, and R. wrote some of his mail, while I kept warm enough to sleep with the help of a hot-water bottle and Garry on one side of the bed. I am ashamed to tell that I slept again after lunch, but got up for tea. I sat outside while R. went out with the gun, but we were both glad to get back into the shelter of the tents.

In spite of heavy snow, Garry made at least six expeditions up the hill, after what we did not know, probably marmots; and Jit Ram said he saw him chasing a "burra janwar," a big animal, which I think must have been a hare. Garry was tied to a bed that night in case he thought moonlight suitable for further shikar. In dak bungalows where there was a bedstead he was allowed to sleep at the foot of the bed, but there was not much room for a full-grown person and an Airedale weighing 55 pounds on a camp bed. One night he was turned off the bed, and although a comfortable nest was made for him on old blankets surrounded by Gilgit boots, he was annoyed about it, got out under the flap of the tent, and stayed out for an hour, keeping us awake for that time as a fitting punishment for our cruelty; he usually manages to pull our legs somehow.

The previous night it was very late before the dogs got their food, and our dinner was brought first. Both dogs can be trusted not to touch food on the table, but R.'s plate of strong brown soup was put on a chair as I was in bed, and we had no table in the sleeping tent. This was too much for Garry, and he licked it. The hiding which followed only resulted in him standing under the outer flap of the tent, yawning loudly while we ate the rest of our dinner.

I wrote up the diary in bed that night; the wind had fallen. The day before inside our tents was like being on a sailing ship with sails flapping in a storm. There was a beautiful sunset, the first we had seen. We

looked over Chumatang, over the lower hills of the Zanskar range to the heights beyond. All the peaks were clear and rosy in the evening light, and we thought it augured well for a "good" day to-morrow, as we say in Scotland.

I sometimes wondered if, when I did get back to civilization—a vague dream at that time—I should want to talk a great deal or just sit and listen. The discipline of the march allowed of little or no talking, and men can be very monosyllabic creatures at times, unless they are talking shop.

The night of Saturday, May 22, was the coldest we had experienced. I could not tell what the temperature was, but everything possible froze. A washed handkerchief on the rope over my head was frozen stiff; the

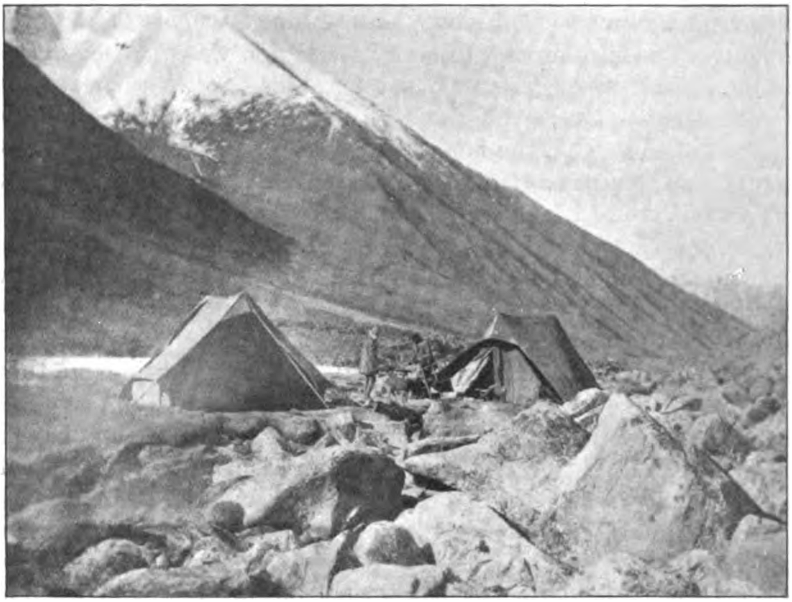


FIG. 17.—Camp above Gungra, over 16,000 feet.

water in the canvas basin and in the bucket was frozen solid. We tried hard to sleep, but the wind came in under the canvas, up the sides of the tent, and through our two little camp beds. We tried several different arrangements of blankets to no purpose. We shivered and remained cold. My fur cap was a necessity for my head, as a piercing wind blew my hair all over my face. We sat up and talked at least every hour, and wondered what we could do to make the tent less draughty for another night. We listened for the bearer coming with tea, but it was cold when it came.

R. started off at six up the nullah in the hope of finding an ammon. The sun came out about 7 o'clock, but in a quarter of an hour it was snowing again. Our camp was over 16,000 feet above sea-level, and we were all conscious of the altitude. When I opened a yakdan or moved a

chair, my energy was exhausted, and I could only sit and pant for two or three minutes. I found that the servants felt this too, and they thought it was caused by the water being bad, and were afraid if they stayed there any longer they would be very ill. I laughed and told them it was only the height, and that the sahib and I were just the same. I thought they had better get busy and stop thinking so much. I put the boy and the sweeper on to making the tent a little less draughty by putting pieces of turf and clods of earth all round the curtain and then stones on top. I gave the khansamah some sour milk and told him to make scones. I called the bearer and got some hot water to do washing. Unfortunately the socks froze stiff hanging in the sun, but the whole camp was cheerier in an hour's time. We heard Garry's distant yapping far up the hillside. It did not seem to matter to him whether the temperature was below zero or not, so long as there were marmots to chase.

I had been wondering what luck R. was having, when about 12 o'clock, as I was having my tiffin of rice soup, we heard three shots, which meant that R. was not far off. I was afraid the shots were too near to mean ammon, but thought he had probably got a hare. In a few minutes they appeared, walking on the snow, and I heard the news. There was no sign of ammon; nothing but snow up the valley, and no possible feeding for animals. The bag was two ram chikor, shot with the rifle, as the gun had been left with me. We gave them to the tiffin coolies, as we had two in hand for ourselves.

We wondered about going down the valley to Chumatang that night, but R., the shikari, and tiffin coolies had been tramping for six hours, and striking camp meant a lot of work, so we decided to stay until next morning. Our tent ought to be cosier, I felt, and would keep out some of the wind now, if not the frost.

After tea, about 3 o'clock, we went out to see if we could get a hare. I heard the shikari sending the boy after us, and I groaned inwardly; not even a stroll without some of these Kashmiris. Luck was with us, however; in a few minutes we got two ram chikor, and R. sent the boy off to cut their throats, and then back to camp with them. We went on our way up the valley, walking on hard snow until we came to a spur on our right, when we scrambled up among the rocks, keeping a sharp lookout for hare, and we saw quite a few in the distance. We were six or seven hundred feet above our camp, and the view was the finest I had seen. There was less wind than we had had in camp, and the sun was warm. There was a fine line of hills to the south, part of the Zanskar range again, and one or two peaks to the north which must have been somewhere near the Chinese frontier. It was very peaceful, only the cry of wild fowl breaking the silence.

We walked on and on, stalking one hare after another until at last we got one, and went down hill to our camp, which had been in shade for quite an hour. We had dinner and then to bed at once, before the cold

was too intense, and the servants were able to wash-up by daylight. I think the temperature was even lower that night, but luckily we were not quite so cold. I slept in my fur-lined coat and again wore the fur cap, and R. had on two jerseys. I kept Garry on the bed all night; if he kept me from sleeping, he also kept me from freezing, and to be fair to him, he lay very still. I was very thankful when tea came at half past five. It was a perfect morning; the sky a deep blue, and not a cloud to be seen. We had breakfast in the sun about 7 o'clock. Our milk was frozen solid in the saucepan. The dogs were having their breakfast when Garry heard a sound and went off hunting, and the remains of his breakfast froze to the dish in a few minutes.

We left before the tents were down, and started with a good swing downhill over the snow bed above the river. There were tiny glaciers here and there, a fine deep blue colour in the morning sunshine. I had to avoid them carefully as I was wearing nailed chapplies; R. was luckier with grass sandals.

R. got another ram chikor; and I was picking some feathers out of it for my hat when I saw it was covered with parasites—not a pleasant discovery! At this moment Garry heard something far up the hill, and we did not see him again for hours.

This valley is called the Chumatang Poo; Poo being the Thibetan word for a valley branching off the main stream. I was walking down the east side of it, while R. went on the other side with the gun. My eyes were a little sore after the four miles on snow, as I had forgotten my glare glasses, when on looking up I saw, only ten or twelve yards away, what looked like two Pekinese puppies; they were exactly that colour. I rubbed my eyes to make sure I was seeing all right, and in ten seconds they were in their holes. They were the first marmots I had seen.

We had intended to have tiffin on the top of a bluff overlooking the village, but the last three miles lay across a mass of boulders, much too uncomfortable, and even too hot with the reflection of the sun, so we went right down to the village and sat on a turfy bank beside a pond. Our camp was pitched where the Tehsildar had his tents, purely a matter of prestige with the shikari, as our last place was much more sheltered, had turf underfoot, and so was not nearly so dusty.

I fell sound asleep for more than an hour. The warmth after the piercing cold up the valley made me drowsy I suppose. We had opened our one tin of tongue that morning, and it was delicious. After nothing but game for a month, salt tongue was a delightful change. It had been given to us, and we blessed the kind donor.

R. had a very painful inflamed eye, a slight attack of snow blindness, so we did not go up the river after duck as we had intended, but each had a bath while the sun was still on the tent. After studying the map, R. thought he would like to try going up the streams on either side of Kaisser, as burrhel were supposed to be plentiful there, and we had given up all

hope of getting an ammon. So our plan was to go to Kaisser next day if fuel was available there.

The people of Chumatang were not so pleasant as other Ladakhis. The servants had difficulty in getting milk, and when dishes were given for milk to be brought in, they were not returned. Probably the head man of the village was rather a rogue, as this was anything but characteristic of the country people.

Chumatang has a delightful situation, the valley is broader there, and although I can remember only one stunted tree in the middle of the village, the edges of the fields were green, and the whole place had a tidy, well-kept appearance.

(*To be continued.*)

Current Literature.

STREETER, H. W. **Experimental Studies of Water Purification. VI. General Summary and Conclusions.** *Pub. Health Rep.* Wash., 1933, v. 48, 377-400, 10 figs. [Refs. in footnotes.]

Some of the previous reports for the experimental station at Cincinnati have been summarized [this *Bulletin*, 1927, ii, 637; 1928, iii, 275; 1931. vi, 73]. The present report deals only with some of the more important results. Comparisons were made of the efficiency of purification by the method of coagulation-sedimentation followed by filtration and post-chlorination when applied to three different raw waters. Although the ultimate results were approximately equal, the relative efficiency of the different stages was markedly different. It is possible that this divergence is in part due to differences in pH of the raw water as the bacterial efficiency of coagulation-sedimentation is sharply diminished at pH values exceeding 7·0 or thereabouts; the water which was least purified at this stage had a pH of 7·8 to 8·2. The general results appear to justify the current tendency in rapid sand filtration plants to depend largely on chlorination for bacterial removal and assign to the preliminary sedimentation and filtration processes merely the function of clarification.

Experiments on variations in the conditions of coagulation with aluminium sulphate led to the following conclusions: (1) the efficiency is diminished with pH values exceeding 7·0 and improved with values approaching 5·5; (2) the efficiency depends on the amount of coagulant added and the total period of sedimentation. There appears to be no difference between double-stage and single-stage coagulation provided the total amounts of coagulant and the period of sedimentation are the same in both cases.

Studies on the excess-lime process indicate that viewed apart from its function in water softening, the treatment has not the same advantages as pre-chlorination in reducing bacterial numbers. A well-marked bacteria

reduction in lime-treated waters occurs only when the residual pH approaches or exceeds 10·0. The relationship between raw and purified waters in respect of concurrent variations in their bacterial quality appear to be governed by a fundamental law. The restrictions imposed by such a law on the efficiency of bacterial removal are such as to limit the average quality of effluent obtainable by a particular combination of treatment from a raw water of a given average degree of pollution.

The effect of storage, a treatment which has not been greatly used in America hitherto, was also studied and it is likely that both natural and artificial storage will assume a rôle of increasing importance in the development of water purification systems in the States.

M. E. DELAFIELD.

Reprinted from "Bulletin of Hygiene," Vol. 8, No. 8.

ALI, M. **"Verdunisation," the Bunau-Varilla Process for Chlorination of Water, Description and Testing.** *Tech. Gemeindebl.* 1932, v. 35, 269. [Summary taken from *Dept. Scient. & Indust. Res. Water Pollution Research. Summary of Current Literature.* 1933, v. 6, 150.]

The author gives an historical account of the discovery, nature and application of the process of Verdunisation and discusses the theory of the bactericidal action of rays liberated by the attack of hypochlorite on organic matter and the nature of the evidence in favour of the process. In published results of experiments the chlorine demand of the water used has not been given, parallel experiments without shaking have either not been carried out or have been made by adding the chlorine to still water so that there is not complete contact between chlorine and water, and Vincent's colorimetric method, which loses its sensitivity with damaged *B. coli*, has been used. The author then describes parallel experiments made with water chlorinated with about 0·1 mg. per litre and vigorously shaken, water chlorinated and shaken only sufficiently to ensure thorough mixing, and unchlorinated water. The chlorine demand was determined before and after chlorination and was found to decrease considerably. The results showed that it was not always possible to disinfect clear water, regardless of its chlorine demand, with 0·1 mg. per litre of chlorine. Vigorous agitation was found to have no effect on the bactericidal action of chlorine. The only advantage of vigorous agitation appears therefore to be that of rapid mixing.

Reprinted from "Bulletin of Hygiene," Vol. 8, No. 8.

GOUDEY, R. F. **Recent Trends in the Field of Sewage Sludge Digestion.** *Munic. San.* 1932, v. 3, 289. [Summary taken from *Dept. Scient.* and *Indust. Res. Water Pollution Research. Summary of Current Literature.* 1933, v. 6, 168.]

Abstract of a paper presented to the California Sewage Works, Assoc., May, 1932. Research has shown that to procure a digested sludge with a

lower water content and better dewatering properties attention must be paid to enzymes, catalysts, and filamentous bacteria. Digestion at pH 5·5 in the presence of iron and lipase, followed by second stage digestion at pH 7·5 in the presence of diastase, with use of lime for conditioning, will break down amino acids, give a sludge of low water content which is rapidly dewatered, and increase gas production. The agencies which cause and control bulking in activated sludge also affect bulking in fresh and digested sludges. Foaming in Imhoff tanks is comparable with bulking in activated sludge. Reduction of alkalinity in sewage during treatment has been found to be almost equal to the increase of alkalinity in digested sludge *plus* the equivalent represented by the carbon content of the gas, suggesting a distinction between the inorganic alkalinity of the sewage and what may be termed organic alkalinity subject to change by bacterial action. Sludge from thermophilic digestion is difficult to dewater, odorous, and apt to breed flies on drying beds. Return of overflow liquor from digestion tanks to the raw sewage adds to the oxygen demand and suspended solids content and introduces products of decomposition. The problem has been solved by drawing off digested sludge simultaneously with the introduction of fresh sludge; the water content of the digested sludge is thus increased about two per cent, but a conditioned sludge can be thickened, giving a clear water whose disposal offers no difficulty. (*Sewage Works J.* 1932, v. 4, 609).

Reprinted from "Bulletin of Hygiene," Vol. 8, *No.* 8.

Reviews.

ANNUAL REPORT OF THE SURGEON-GENERAL OF THE PUBLIC HEALTH SERVICE OF THE UNITED STATES FOR THE FISCAL YEAR 1932. Washington: Government Printing Office. Price $1.00 (cloth).

This is the sixty-first annual report which has been issued during the 134 years existence of the Public Health Service of the United States, and it covers the work of the Service for the year ending June 30, 1932, with health figures for the year 1931. Surgeon-General H. S. Cumming in submitting the report to the Secretary of the Treasury gives a brief summary of health conditions during the year, and of various activities of the Public Health Service. He states that the increasing use of international aerial transport makes it of special importance that current information relating to the prevalence of disease in foreign countries be available. Those who study the monthly *Bulletin* of the Public Health Service realize how minutely epidemiological records from all parts of the globe are summarized and widely distributed.

The Public Health Service can again be congratulated on the fact that no case of quarantinable disease gained admission to the United States.

One case of typhus fever and one of smallpox arrived at quarantine stations and were detained there. The general state of health kept at a high level in spite of unfavourable economic conditions.

The birth-rate in 1931 was 17·8 per 1,000, and at the time of publication of the report it was estimated that the death-rate would be approximately 11 per 1,000.

The death-rate from tuberculosis reached a record low level, that reported from forty-three States being 66·3 per 100,000, compared with 68·8 per 100,000 in the previous year.

During the summer and autumn of 1931 there was a considerable epidemic of poliomyelitis, chiefly in the north-eastern States. In Connecticut there were 70 cases per 100,000 of population, while in forty-two States the average rate was 15 cases per 100,000, the highest figure since 1916, when there were 41 cases per 100,000. The incidence of smallpox in 1931 decreased to 24·4 per 100,000 of population, which is the lowest ratio since 1916.

The work of the Division of Scientific Research is briefly described in the report, the diseases investigated being cancer, heart disease, leprosy, malaria, plague, Rocky Mountain spotted fever, tularæmia, tick paralysis, Colorado tick fever, and relapsing fever. Also stream pollution, milk supply, and child hygiene were amongst other subjects of investigation.

The leprosy bacillus appears to have been found in the blood of eight patients in a group of twelve selected cases of leprosy examined. Three cubic centimetres of blood obtained by venipuncture were hæmolyzed in acetic acid and sterile distilled water. Only bacilli found in white blood cells or in groups of two or more were accepted. The report states that this suggestive evidence of a bacteræmia is of interest, as it would explain the occurrence of active manifestations of the disease which have been looked on as being phenomena of allergy.

A considerable amount of work was carried out on the prevention and treatment of malaria.

The effect of plasmochin as a prophylactic was investigated in the Panama Canal Zone, and it was considered that the results, although not definite, were very encouraging.

The action of atebrin in the treatment of benign tertian malaria was considered to be so good that further tests on a large scale have been begun.

Observations made at Miami showed that about twenty per cent of aeroplanes arriving from tropical countries harboured one or more species of mosquito. Subsequently *Aëdes ægypti* were set free in aeroplanes in San Sebastian, Central America, and, on arrival of the machines at Brownsville and Miami fifteen to twenty per cent of the liberated mosquitoes were recovered, and it was observed that altitudes of 15,000 to 16,000 feet had apparently no harmful effect on the mosquitoes.

The Division of Venereal Diseases carried out a large amount of

work noted under the headings of Scientific Research, Clinical Research, Prevalence Statistics, Health Education, etc., and brief summaries are given in the report.

Experiments were made, and are being continued, on the immunological effect of various fractioned portions of gonococcus toxin.

The work of the Quarantine Staff during the year is described, with numerous tables of statistics, and summaries are given of the work of the Marine Hospitals.

It must be no small task to compress the annual reports of so many Departments of a large Service into a small volume of under 200 pages, and to present them in a lucid and interesting form, as has been done in the report under review.

MINOR MALADIES AND THEIR TREATMENT. By Leonard Williams, M.D. Sixth edition. London : Baillière, Tindall and Cox. Pp. xiii + 420. Price 10s. 6d.

In preparing this edition of his well-known book nine years after its predecessor, Dr. Williams has contented himself with bringing the subject matter up to date and has wisely left its familiar qualities unaltered. It remains the same useful volume, full of practical hints for diagnosis and treatment and affording much food for thought in its enunciation of the author's theories and opinions.

The chapter on Goutiness has been replaced by one entitled Salient Symptoms ; that on Dyspepsia has been largely rewritten and expanded. Dr. T. G. Cobb has been entrusted with the writing of the chapter on some Drugs and their uses.

It would be superfluous for us to recommend this work—the success of the previous editions tells its own tale.

THE THEORY AND PRACTICE OF MASSAGE AND MEDICAL GYMNASTICS. By Beatrice Goodall-Copestake. Fifth Edition with 118 Illustrations. London : H. K. Lewis and Co. 1933. Pp. xx + 332. Price 12s. 6d.

This work is intended for the use of students qualifying in the science and art of massage. It commences with a brief history of massage and hints to beginners, and goes on to describe the various forms of massage and their physiological effects on the body.

Practical massage and muscle re-education are then dealt with fully and clearly.

Chapter VII deals with kinesiology briefly but adequately for the purposes of the book.

Active and passive movements are well described, and in each case the action of the muscles involved is given.

The statements in the chapter on respiration that the quadratus lumborum is a muscle of inspiration and that "raising the arms in various ways is a help to inspiration" are open to question.

The special treatment of many surgical and medical conditions is well and clearly laid down.

The book throughout is clear and concise. It is illustrated by many excellent plates, photographs, drawings and diagrams. It can be recommended to the student contemplating massage as a profession.

R. W. G.

CARDIOVASCULAR PAIN AS A BIOCHEMICAL PROBLEM. By Gordon Lambert, B.A., M.D., B.C.Cantab., and Maurice Alan Cassidy, C.B., M.A., M.D.Cantab., F.R.C.P.Lond. London: H. K. Lewis and Co., Ltd. 1933. Pp. xi + 75. 23 illustrations. Price 6s. net.

In a monograph of some 75 pages the authors discuss the various theories which have from time to time been advanced as to the causation of anginal pain.

The problem is attacked by a consideration of the muscular and vascular factors which may operate in the production of the anginal syndrome as contrasted with the possible neural causes.

In both chapters there is detailed reference to the work of many well-known writers with illustrative cases.

The authors sum up the evidence in an able commentary in which they incline to the belief that a chemical variation from normal in the blood may account for the syndrome where no other discoverable cause exists.

The monograph is a useful contribution to present knowledge on this vexed subject and will be of interest to cardiologists.

There is a foreword by Dr. M. A. Cassidy which should certainly not be neglected by any reader of this monograph. We are in full agreement with Dr. Cassidy's dislike of the term "*angina minor*" which is one that should disappear from medicine.

THE COMMON CAUSES OF CHRONIC INDIGESTION. DIFFERENTIAL DIAGNOSIS AND TREATMENT. By Thomas C. Hunt, B.A., D.M., M.R.C.P. London: Baillière, Tindall and Cox, 1933. Pp. vii + 341; plates 16. Price 12s. 6d.

This volume is a very useful addition to the Minor Monograph Series. It gives a practical outline of present-day views upon the subject, and is based as far as possible, the author states, upon personal experience.

Besides chapters discussing the various disorders that give rise to chronic indigestion, others are devoted to descriptions of the principal methods of investigation—specially detailed as regards those the general practitioner can carry out for himself—indigestion in old age; alcohol in digestion, etc.

A few prescriptions and an excellent bibliography of the latest literature on the subject complete the work.

In this book, the practitioner and student will find much to help in the investigation and treatment of conditions that are so commonly met with and are so frequently puzzling.

Correspondence.

PUERPERAL SEPSIS.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—I have been reading a report of a meeting of the Section of Obstetrics and Gynæcology in the *British Medical Journal* of August 5, 1933. The subject was "Puerperal Sepsis" and I gained the following information: Dr. Leonard Colebrook considers that the majority of cases are due to infection from the throat of the attendant and advocates the use of masks. Dr. Farquhar Murray (Newcastle) states that in the Princess Mary Hospital, 68 per cent. of the staff were carriers of hæmolytic streptococci; yet out of 183 clean cases attended only three developed sepsis and that was of a trifling form. Masks were presumably not worn. Dr. Joan Rose (Edinburgh) advocates the use of masks. Dr. G. W. Theobald says that masks have been shown to be useless. Dr. Bethel Solomons says that at the Rotunda he does not use masks and in the past seven years 26,000 cases have been delivered without an outbreak of sepsis, and that recently 100 members of the staff had been examined and no hæmolytic streptococci were found.

This report leaves the question of masks undecided, and yet it seems that common sense is in favour of masks. As a student I was taught that saliva is given us to start digestion, to assist deglutition and to help us to talk. It was pointed out that some of us are dry talkers and some wet talkers, but that even dry talkers might inoculate a Petri dish over which they talked. In any case no one assisting at an operation is asked, "Are you a wet talker?" or even "Have you hæmolytic streptococci in your throat?" They are simply provided with masks.

The answer seems to be, "If I am going to do a vaginal examination, I will either keep my mouth shut or I will wear a mask."

Landour. I am, etc.,

August 31, 1933. R. D. DAVY,

Major, R.A.M.C.

Notices.

ALLERGILAC.

ALLERGILAC is a modified milk product manufactured by Cow and Gate, Ltd., for use in the feeding of infants suffering from allergic manifestations (eczema, dermatitis, asthma, sudden afebrile bronchitis, etc.) on taking cow's milk or sometimes even breast milk.

In the new product a considerable amount of protein has been removed, acid deficiency is compensated, and early digestion of protein is encouraged.

Allergilac is supplied as a powder which, the manufacturers state, when

diluted to 1 in 8 forms a reconstituted milk of the following composition: moisture 88 per cent, fat 1·9 per cent, casein 3 per cent, lactalbumin 0·1 per cent, ash 0·8 per cent, and lactose 6·2 per cent. The acidity is 27° and pH value 6.

"HYPOLOID" BISMUTH OXYCHLORIDE.

BISMUTH OXYCHLORIDE is a water-insoluble salt for the injection treatment of syphilis. "Hypoloid" Brand Bismuth Oxychloride, suspended in a sterile isotonic saline solution, is prepared by Burroughs Wellcome and Co., and issued in rubber-capped bottles of 25 cubic centimetres containing 0·1 gramme of the medicament per cubic centimetre. It is stated to be an effective method for the introduction of bismuth into the tissues. It is said to be well tolerated in respect of pain and nodosities and is absorbed at a uniform rate, which, without causing toxic symptoms, produces effective anti-spirochætal effect.

CHADWICK PUBLIC LECTURES—NOVEMBER AND DECEMBER, 1933.

Date and Time	Place	Lecturer	Subject	Chairman
November	LONDON			
Thursday, 2nd, 5.30 p.m.	Hall of the Royal Society of Tropical Medicine & Hygiene. Manson House, 26, Portland Place, W.1	Percy Flemming, Esq., M.D., B.S., F.R.C.S., F.S.A.	The Sanitary Arrangements of the Mediæval Monastery	W. E Riley, Esq., F.R.I.B.A., M.Inst.C.E., Chadwick Trustee
Tuesday, 14th, 5.30 p.m.	Hall of the Royal Society of Tropical Medicine and Hygiene, Manson House, 26, Portland Place, W.1	R. O. Moon, Esq., M.D., F.R.C.P.	"Malcolm Morris Memorial" Lecture, Housing and Town - Planning in Relation to Public Health	Sir James Crichton-Browne, M.D., F.R.S., Chadwick Trustee
Tuesday, 14th, 8 p.m.	READING The University	E. G. Haygarth Brown, Esq., I.S.O., formerly of the Ministry of Agriculture	Standards of Food in Relation to Public Health	Professor H. D Kay, O.B.E., Ph.D., D.Sc.
Tuesday, 21st, 8 p.m.	LONDON The London School of Hygiene, Keppel Street, Gower Street, W.C.1	Dr. Charles Porter, President of the Society of Medical Officers of Health, and Mr. W. H. Draper, Sanitary Inspector, Marylebone	"Bossom Gift" Symposium. The One-pipe System of House Drainage in Theory and Practice	Alfred C. Bossom, Esq., M.P.
December				
Tuesday, 5th, 8 p.m.	The Institution of Mechanical Engineers, Storey's Gate, St. James's Pk., Westminster	J. H. Coste, Esq., F.I.C., F.Inst.P., Chemist to the L.C.C.	Rural Sanitation, with Special Reference to Isolated Houses and Institutions where there is no main drainage	Sir William J. Collins, K.C.V.O., M.D., Chairman of the Chadwick Trustees

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No. 6. December, 1933. Vol. LXI.

at Britain

Journal

OF THE

Royal Army Medical Corps

ISSUED MONTHLY

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CONTENTS.

JOHN BALE, SONS & DANIELSSON, LTD.
83-91, GREAT TITCHFIELD STREET, LONDON, W.1

Price Two Shillings net

VOL. LXI DECEMBER, 1933. No. 6

Authors are alone responsible for the statements made and the opinions expressed in their papers.

Journal
of the
Royal Army Medical Corps.

Original Communications.

BLOOD-SUGAR ESTIMATION.

By COLONEL C. BIRT
(Retired Pay).

THE discovery of insulin has been the most dramatic and important therapeutic event of the century. Dr. R. D. Lawrence [1], the biochemist of King's College Hospital, London, writes that he had suffered severely from diabetes and was now healthy and vigorous after being treated with insulin. The adult sufferer had, before the discovery of insulin, the prospect of a living death, at the most four years. The average young patient died within two years, while infants succumbed within two or three weeks. He had been compelled to give up work and live for a time on starvation diet, but now he was mentally and physically strong, and could work fourteen hours daily and walk and climb as much as he wished. He felt so strongly about people who opposed the testing and issuing of insulin that no other term than well-meaning murderers was applicable to them, and in that remark he believed that he had the support of thousands of his fellow-subjects of the disease: they could scarcely be called sufferers now.

In order to determine the dose of insulin that will be necessary, blood-sugar estimations are essential. The blood is tested before breakfast, again five hours after the dose of insulin, and again three or four hours later. The tests, indeed, are a matter of life or death in diabetic coma of patients who are under treatment with insulin, for the blood-sugar may fall suddenly and an additional dose of insulin may precipitate a fatal hypoglycæmia.

Blood-sugar estimations are also requisite for the accurate diagnosis of diabetes.

The usual procedure [2] is to administer fifty grammes of dextrose in three or four hundred cubic centimetres of water and to determine the blood-sugar in five samples of blood taken at half-hourly intervals, one before and four after the dextrose drink.

MILLIGRAMMES OF DEXTROSE PER 100 CUBIC CENTIMETRES OF BLOOD.

	Before	½ hour after	1 hour after	1½ hours after	2 hours after
Normal	100	120	130	110	100
Lag curve	100	150	230	140	120
Mild diabetes	170	187	198	190	182
Severe diabetes	240	270	294	300	314
Renal glycosuria	98	100	94	96	98

Leak point of kidney 180.

Until the clinical importance of blood-sugar values was apparent, biochemists generally made use of five cubic centimetres of blood drawn from a vein for their tests, but on the need arising of repeated examinations, search was made for micro-chemical methods which would require 0·1 cubic centimetre of blood only, such as may be obtained from a finger-prick. Bang originated a process of this kind and about a dozen modifications of his have been introduced. They involved the use of expensive apparatus, platinum crucibles, micro-balances, tintometers, colorimeters, centrifuges, etc., and were not free from defects. It was the object of the writer to ascertain if reliable quantitative blood-sugar tests could be made with laboratory equipment of quite modest proportions.

In the year 1859 Gentele [3] discovered a method of dextrose estimation by means of potassium ferricyanide in alkaline solution, which is quantitatively reduced by dextrose. He found [4] that urea, uric acid, and ammonia and its salts, caused a similar reduction, hence the reagent was worthless for urine analysis. The process, therefore, was lost sight of by biochemists until revived and elaborated by Hagedorn and Jensen [5] for the micro-chemical estimation of blood-sugar after many futile experiments with dyes, etc.

Their paper appeared in the year 1923. Dr. G. Graham, Assistant Physician of St. Bartholomew's Hospital, described Hagedorn and Jensen's test in the second edition of his "Pathology and Treatment of Diabetes Mellitus," 1926, where he states that he has adopted it in place of Bang's which he had used before. Duggan and Scott [6] obtained accurate results with Hagedorn's test over a range of 23 to 200 milligrammes dextrose per 100 cubic centimetres of blood. Citron [7], who had worked with Bang's micro-test for two years, obtained much better results with Hagedorn's. Pucher and Finch [8] investigated the comparative merits of the various micro-methods. Hagedorn's gave more uniform and consistent results than the others. Hanes [9] has modified the process for the estimation of larger quantities of dextrose. Kramer and Steiner [10] secured reliable readings

up to 350 milligrammes per 100 cubic centimetres of blood by adding known quantities of dextrose. They gave a table from which a graph could be drawn which is nearly a straight line. Hulme and Narain [11] also find that a linear relation exists between the dextrose and ferricyanide reduced over a range of 20 to 300 milligrammes of dextrose per 100 cubic centimetres. G. A. Harrison [12] gives a full account of the manner of carrying out the test and the interpretation to be put on blood sugar curves. Professor M. Jacobi [13] of Berlin, notes the advantages of Hagedorn's over other micro-tests. Worsley and Nutman [14] use Hagedorn's process for the determination of sugar in the vegetable kingdom. In common with most observers they remark that the figures become less consistent when the dextrose exceeds 300 milligrammes per 100 cubic centimetres. Peters and Van Slyke [15] state that Hagedorn's test is so convenient that it has been almost universally adopted throughout Europe. Formiguera [16] prefers it to all others. Widdowson [17] also has made exhaustive studies of the method.

The subject has engaged the attention of the writer for two years, during which he has carried out more than 1,400 titrations in connection with Hagedorn's test. He has worked with known dilutions of dextrose, and with 289 samples of normal blood, diabetic blood and with blood to which measured amounts of dextrose have been added. He has convinced himself of the reliability of the method, and of the ease with which it can be performed with but little apparatus. Indeed, some diabetics, who are all now taught to use Benedict's qualitative test daily, have learnt how to measure their blood sugar in this manner.

Since a description of Hagedorn and Jensen's test is not included in some of the recent works on clinical pathology and laboratory methods, it is hoped that the minute details given here may be of use to those called upon to treat diabetes, who may be far removed from a biochemical laboratory or medical library, and are concerned that their patients shall not suffer thereby.

Dextrose disappears rapidly from blood *in vitro* [18, 19, 20], therefore there should be no delay in the examination. Glycolysis also occurs in oxalated blood [21]. Fluorides tend to arrest it [22]. Graham [23] adds 0·02 gramme of a mixture of four parts of potassium oxalate and one of potassium fluoride to 5 cubic centimetres of blood. Lax and Szunat [24], and Ewing [25] state that the addition of 1 per cent sodium fluoride and 0·1 per cent mercuric chloride preserves the dextrose in the blood. Ionescu-Matiu [26] adds 0·4 per cent sodium fluoride to the blood. Rose and Schattner [27] fuse together 15 grammes of sodium sulphate and 0·2 gramme of sodium fluoride, and the powdered result is intimately mixed with 0·1 cubic centimetre of blood. This treatment with fluorides generally hinders glycolysis, but sometimes fails notably. Hence to prevent such avoidable errors, the tests should be begun immediately after withdrawing the blood.

If familiar with Sir Almroth Wright's technique of rubber teat and

pipette, no difficulty will be experienced in making the exact measurements required. Automatic pipettes delivering 0·1, 0·05, and 0·01 cubic centimetre are made [28], and their accuracy is proved by ascertaining that ten, twenty and a hundred times their measure of mercury respectively weigh exactly 13·56 grammes, which is the weight of 1 cubic centimetre of mercury at 15° C. This can be weighed in dispensing grain scales sensitive to a centigramme. The 1 cubic centimetre pipette should be checked in like manner. A 10 cubic centimetre and a 100 cubic centimetre glass measure and a Liebig's glass condenser for distilling water are necessary.

The following "Analytical Reagents" in approximate quantities must be procured from a reliable source and guaranteed "AR."

Potassium ferricyanide, free from ferrocyanide	..	25 grammes
Sodium carbonate, anhydrous, free from Fe ..	..	250 ,,
Zinc sulphate ,, ,, ..	..	500 ,,
Sodium hydrate ,, ,, ..	..	100 ,,
Sodium chloride ,, ,, ..	..	500 ,,
Sodium thiosulphate ,, ,, ..	..	250 ,,
Potassium iodate ,, ,, ..	..	25 ,,
Potassium iodide ,, ,, ..	..	100 ,,
Glacial acetic acid ,, ,, ..	..	100 ,,
Starch, ordinary	..	100 ,,
Dextrose, pure A. R.	..	100 ,,

The solutions required are :—

(1) Zinc sulphate 45 grammes dissolved in distilled water and made up to 100 cubic centimetres.

(2) Sodium hydrate, decinormal, 0·4 gramme to 100 cubic centimetres distilled water. This must be renewed weekly.

(3) Potassium ferricyanide, N/200, 1·65 gramme to the litre, and sodium carbonate N/5, or 10·6 grammes to the litre. Since this solution deteriorates after some weeks, it is advisable to make this smaller quantity, which is more convenient for weighing :—

Potassium ferricyanide	..	0·4 gramme
Sodium carbonate, anhydrous ..	..	2·58 grammes
Distilled water	to	242·42 cubic centimetres.

The ferricyanide must be weighed and the solution measured with great accuracy. Exposure to light damages this reagent. Two cubic centimetres need 2 cubic centimetres of N/200 sodium thiosulphate solution to discharge the colour after adding 3 cubic centimetres of solution (4) and 2 cubic centimetres of solution (5).

(4)	Zinc sulphate	..	10 grammes
	Sodium chloride	..	50 ,,
	Distilled water	..	200 cubic centimetres.

To 40 cubic centimetres of this 1 gramme of potassium iodide is added as wanted, since the iodide is not stable when thus dissolved.

(5) Acetic acid 3 per cent dilution in distilled water.

(6)	N/10 Sodium thiosulphate ..	..	2·48 grammes
	Distilled water	to	100 cubic centimetres.

N/200 sodium thiosulphate is prepared from this by diluting twenty times. This dilution must be titrated with the potassium iodate before use.

(7) Starch one gramme is mixed with 20 cubic centimetres of cold distilled water and washed into 60 cubic centimetres of boiling distilled water, boiled for two minutes, 20 grammes of sodium chloride added, and made up to 100 cubic centimetres with distilled water. Thus prepared it remains serviceable for months.

(8) Potassium iodate, Molar/1200 or 0·1783 gramme to the litre. To prepare this, make a M/120 solution by dissolving

Potassium iodate	0·2 gramme
Distilled water	112·14 cubic centimetres.

This must be done with great accuracy.

One part of the M/120 solution is made up to ten parts with distilled water at intervals of a week. Although Hagedorn states that the M/1200 dilution is absolutely stable, "unbedingt haltbar," moulds may be found in it after the lapse of weeks, which reduce its strength.

Potassium ferricyanide, $K_3Fe(CN)_6$, is reduced by dextrose in alkaline solution to potassium ferrocyanide, $K_4Fe(CN)_6$; the amount of the ferricyanide which remains unreduced is found by converting it into ferrocyanide with potassium iodide and acetic acid, by which iodine is set free, according to the equation, $2K_3 Fe(CN)_6 + 2KI = 2K_4Fe(CN)_6 + I_2$. The iodine is then estimated by titrating with sodium thiosulphate, with starch as an indicator:—

$$2Na_2S_2O_3 + I_2 = 2NaI + Na_2S_4O_6$$

Thus we learn the amount of ferricyanide which was not reduced by the dextrose, and knowing the total quantity of ferricyanide which was present originally, the difference gives the amount of ferricyanide reduced by the dextrose.

The reaction of the ferricyanide with the iodide is reversible, so it is necessary to remove the ferrocyanide as soon as it is formed, by means of zinc sulphate in excess with which it yields a very insoluble compound, zinc potassium ferrocyanide,

$$2K_4Fe(CN)_6 + 3ZnSO_4 = K_2Zn_3(Fe(CN)_6)_2$$

To carry out the test, the proteins of the blood must be removed. This is effected by heating with zinc hydrate.

Five cubic centimetres of a 0·45 per cent zinc sulphate solution are prepared by measuring 0·05 cubic centimetre of the 0·45 per cent zinc sulphate solution and making it up to 5 cubic centimetres with distilled water. One cubic centimetre of the N/10 sodium hydrate solution is added, whereby a flocculent precipitate is produced. Both the 0·45 per cent zinc sulphate and the N/10 sodium hydrate must be freshly prepared.

From a finger prick 0·1 cubic centimetre of blood is measured exactly with a verified pipette, or often it is easier to take two measures of 0·05 cubic centimetre each, which are drops of large size, while 0·1 cubic centimetre may run down the finger. The blood is added to the zinc hydrate,

and the pipette washed with the fluid. The test-tube containing the mixture is placed in boiling water for three minutes. Clots form leaving the liquid clear. Filter while hot through a small plug of cotton-wool which has been boiled and dried. The wool should not be compressed too tightly. The protein clot which collects on the surface forms a most efficient filter. The result is a crystal-clear filtrate. If there is the least trace of opalescence in it, it must be passed through the filter again, for this haze indicates the presence of protein, which even in infinitesimal amount quite vitiates the results. The test-tube and filter are then washed with 3 cubic centimetres of distilled water twice. Add 2 cubic centimetres of the potassium ferricyanide reagent (3), measured with the utmost exactness, and place the tube in a boiling-water bath for fifteen minutes. Cool under the water-tap, and add 3 cubic centimetres of the iodide-zinc solution (4) and 2 cubic centimetres of the 3 per cent acetic acid (5); not so great accuracy is required for these last two measurements, since the reagents entering into the reaction are in great excess. The fluid is now yellow from the setting free of iodine. N/200 sodium thiosulphate solution is added slowly and carefully with the 1 cubic centimetre pipette until a trace only of the yellow colour remains. With a glass rod one drop of the starch solution (7) is added, which gives a blue tint immediately. The titration is continued with the 0·1, 0·05, and 0·01 cubic centimetre pipettes until the colour is discharged. The end-point is sharp and occurs after the addition of 0·01 cubic centimetre of N/200 thiosulphate, which represents 1·9 millionths of a gramme of dextrose only. It is evident, therefore, that the test is one of extreme delicacy, and herein lies the absolute necessity of scrupulous cleanliness of test-tubes. The merest trace of protein left in a tube after coagulating the blood will give rise to large errors. Hence avoid the tubes used for this purpose. The amount of dextrose in 0·1 cubic centimetre of normal blood varies from 80 to 150 millionths of a gramme. The limits of the experimental errors which may arise are thus about thirty times less than the range of fluctuations of the dextrose in normal blood. The dextrose-content of the blood in milligrammes per 100 cubic centimetres, corresponding to the number of cubic centimetres of N/200 sodium thiosulphate used, is read from the Sugar Conversion Table.

It is necessary to carry out blank control experiments in every case, in all respects similar to that described, except that there is no blood added to the reagents, for ferricyanide solutions undergo some spontaneous reduction on heating for fifteen minutes. The dextrose corresponding to the number of cubic centimetres of N/200 thiosulphate used in this blank test is subtracted from that found in the blood-test. The difference gives the number of milligrammes of dextrose in 100 cubic centimetres of blood. The titration should not be delayed after adding the iodide zinc solution, for Widdowson [17] has found that when the tubes were allowed to stand at room temperature for ten minutes, there was a loss of iodine equivalent to 0·01 cubic centimetre of N/200 thiosulphate; and after an hour a loss

equal to 0·08 cubic centimetre of N/200. If the tubes were kept on ice none of the iodine escaped. Formiguera [16] has confirmed these observations.

The N/200 sodium thiosulphate solution is very unstable, and is no longer N/200 after one or two days. Its titre must always be ascertained before use by titrating the M/1200 potassium iodate solution with it, 1 cubic centimetre of which is exactly equal to 1 cubic centimetre of N/200 thiosulphate. For this purpose 2 cubic centimetres of the M/1200 potassium iodate solution are measured very carefully, 3 cubic centimetres of the iodide-zinc solution are added and 2 cubic centimetres of 3 per cent acetic acid. This reaction then takes place:

$$KIO_3 + 5KI + 6CH_3COOH = 3I_2 + 6CH_3COOK + 3H_2O.$$

The thiosulphate solution to be tested is then added to the mixture slowly and carefully with the 1 cubic centimetre pipette until the yellow tint has almost disappeared, a drop of starch added, and the titration completed with the 0·1, 0·05 and 0·01 cubic centimetre pipettes. It will be but seldom that exactly 2 cubic centimetres of the thiosulphate solution

SUGAR CONVERSION TABLE.

MILLIGRAMMES OF DEXTROSE PER 100 CUBIC CENTIMETRES OF BLOOD.

Sodium thiosulphate N/200	0	1	2	3	4	5	6	7	8	9
c.c.										
0·0	385	383	381	379	377	375	373	371	369	367
0·1	365	362	360	358	356	354	352	350	348	346
0·2	344	342	340	338	336	333	331	329	327	325
0·3	323	320	318	316	314	312	310	308	306	305
0·4	303	301	299	297	294	292	290	288	286	284
0·5	282	280	278	276	274	272	270	268	266	264
0·6	262	260	258	256	254	253	251	249	247	245
0·7	243	241	239	237	235	233	231	229	227	225
0·8	223	221	219	217	215	213	211	209	207	205
0·9	203	201	199	197	195	193	192	190	188	186
1·0	184	182	180	179	177	175	173	171	169	167
1·1	165	163	161	160	158	156	154	152	150	148
1·2	146	144	142	141	139	137	135	134	132	130
1·3	128	126	124	123	121	120	118	116	114	112
1·4	110	109	107	105	103	102	100	98	96	94
1·5	92	90	88	86	84	82	80	78	76	74
1·6	72	71	69	67	65	63	61	60	58	56
1·7	54	52	51	49	47	45	43	41	39	37
1·8	35	34	32	30	28	26	24	22	20	18
1·9	16	14	12	10	8	7	5	4	3	2

is the amount necessary to discharge the blue tint in 2 cubic centimetres of the M/1200 potassium iodate solution. For instance, 2·2 cubic centimetres of the thiosulphate may be required. This means that the number of cubic centimetres of thiosulphate solution used must be diminished in the proportion of 2 to 2·2, by multiplying by the factor 2/2·2, or 0·91, in order to obtain the equivalent amount of N/200 sodium thiosulphate solution. A slide rule enables this to be done rapidly.

In the writer's experiments, a fresh solution of pure dextrose was made

by dissolving 1 gramme in 1,000 cubic centimetres of tap-water; 0·1, 0·2 and 0·3 cubic centimetre of which were tested in a manner similar to 0·1 cubic centimetre of blood, representing 100, 200 and 300 milligrammes of dextrose respectively in 100 cubic centimetres.

In 379 tests with 0·1 cubic centimetre of the 1 in 1,000 dextrose dilution, the mean difference of the number of cubic centimetres of N/200 thiosulphate solution required for the blank and the test respectively was 0·54 cubic centimetre, corresponding to the number 2—0·54, or 1·46 cubic centimetres, in the Sugar Conversion Table. This equals 95 milligrammes per 100 cubic centimetres in Hagedorn's Table, but it is equivalent to 102 milligrammes per 100 cubic centimetres when read from a large scale graph based on Kramer and Steiner's figures.

In 218 tests with 0·2 cubic centimetre of the dextrose dilution, the mean difference between blank and test was 1·0829 cubic centimetre of N/200 thiosulphate, corresponding to the number 2—1·0829 or 0·9171 cubic centimetre N/200 thiosulphate in the Sugar Conversion Table, which is equal to 192 milligrammes per 100 cubic centimetres according to Hagedorn, and 202 milligrammes per 100 cubic centimetres by Kramer's graph.

In 107 tests with 0·3 cubic centimetre of the 1 in 1,000 dextrose solution, the mean difference between the blank and test was 1·582 cubic centimetres N/200 thiosulphate solution, corresponding to the number 2—1·582 or 0·418 cubic centimetre of N/200 thiosulphate in the Sugar Conversion Table, equal to 287 milligrammes per 100 cubic centimetres by Hagedorn, and 297 milligrammes by Kramer. The writer's results, therefore, approximate more closely to Kramer and Steiner's observations than to Hagedorn's, and his Sugar Conversion Table is compiled from the readings of a large scale graph based on the values he obtained.

On plotting Hagedorn's figures of his Sugar Conversion Table, it is seen that they, like Kramer's and the writer's, lie in a nearly straight line, but somewhat below both of these. Hagedorn gave an empirical equation for calculating the dextrose values corresponding to the potassium ferricyanide reduced, and a table of figures which, he thought, erroneously, verified it. For on substituting one set of the values given in his table, in the equation, the other set obtained by solving the equation do not agree with his data. This is not surprising, for his equation is not that of a straight line, but is that of a parabola.

If more than 300 milligrammes of dextrose per 100 cubic centimetres be present, the scatter of the deviations in such tests is greater than in those under that amount. This, too, has been noted by several observers. Hence more reliable determinations can be made by employing 0·05 cubic centimetre of blood only, instead of 0·1 cubic centimetre, when testing the blood of those suffering from severe diabetes.

Still more decisive experiments on the efficiency of the ferricyanide process were made by taking 0·2 cubic centimetre of normal blood,

estimating the dextrose in 0·1 cubic centimetre, and to the remaining 0·1 cubic centimetre adding 0·1 cubic centimetre of a freshly prepared 1 in 1,000 dextrose solution, equivalent to the addition of 100 milligrammes of dextrose per 100 cubic centimetres of blood, before determining the sugar content. This was done in 69 instances. In 20 of these the exact amount of 100 milligrammes was recovered. The mean value obtained in the 69 experiments was 98·23 milligrammes per 100 cubic centimetres with a standard deviation of 4·38, which gives a probable error of $\pm$ 2·95. Hence the result may be thus expressed: 98·23$\pm$2·95 milligrammes of dextrose per 100 cubic centimetres of blood were recovered out of the 100 milligrammes introduced. Naumann's [29] probable error of his blood-sugar values obtained by the ferricyanide process was $\pm$ 4 per cent. The method, therefore, is trustworthy.

As an example of the routine of a blood examination, and of the degree of consistency attained in parallel experiments, the following, the last undertaken, may be quoted.

Sodium Thiosulphate Solution Titration.

To 2 cubic centimetres of M/1200 potassium iodate solution (8) 3 cubic centimetres of the zinc-iodide reagent (4) and 2 cubic centimetres of 3 per cent acetic acid (5) were added. The titration was begun by adding exactly 1·9 cubic centimetres of the thiosulphate solution under investigation, which discharged all but a trace of yellow. The mixture was then stirred with a glass rod which had been dipped in the starch solution, and the titration was continued with the 0·05 cubic centimetre and 0·01 cubic centimetre automatic pipettes. 1·99 cubic centimetres of the thiosulphate were required in all to remove the last trace of blue.

A duplicate test gave 1·98 cubic centimetres as the result
A triplicate ,, ,, 1·97 ,, ,, ,,

The mean then is 1·98 cubic centimetres and the thiosulphate factor is 2/1·98 or 1·01.

Potassium Ferricyanide Solution Titration.

To 2 cubic centimetres of the potassium ferricyanide solution (3) 3 cubic centimetres of the zinc-iodide solution (4) and 2 cubic centimetres of acetic acid (5) were added and titration with the thiosulphate solution was carried out in a similar manner as above. 1·88 cubic centimetres of the thiosulphate solution were required. This number multiplied by the factor 1·01 gives 1·90 which is the quantity of N/200 sodium thiosulphate needed to neutralize the potassium ferricyanide present.

A duplicate test gave 1·92 cubic centimetres of N/200 as the result. No error will arise on account of the ferricyanide solution not being exactly N/200; since the effect of the deficiency in the potassium ferricyanide appears in the smaller amount of N/200 sodium thiosulphate being required in the blank controls. This lessened quantity of thiosulphate when converted into its sugar value indicates apparently a greater degree of self-

reduction of the ferricyanide. The dextrose in the blood tubes will be increased in like amount, so that the difference between the sugar values of the blood tubes and the blanks remains unaffected by the slight deviation from N/200 of the ferricyanide solution.

Blood Tests.

0·4 cubic centimetre of blood was taken from a finger-prick, and was mixed with 20 cubic centimetres of freshly prepared 0·45 per cent zinc sulphate and 4 cubic centimetres of N/10 sodium hydrate solution (2). The tube was placed in boiling water for three minutes and the liquid was filtered while hot through a small plug of boiled cotton wool. The filtrate was crystal-clear. The filter was washed with 12 cubic centimetres of distilled water twice, and 8 cubic centimetres of the potassium ferricyanide reagent (3) were added and the whole was evenly divided in four test-tubes, so that each tube contained 0·1 cubic centimetre of blood and 2 cubic centimetres of potassium ferricyanide solution. The tubes were placed in a boiling water bath for fifteen minutes, cooled under the tap, and to each 3 cubic centimetres of the zinc sulphate-iodide solution (4) and 2 cubic centimetres of acetic acid (5) were added. Titration with the sodium thiosulphate solution was begun with the 1 cubic centimetre pipette and continued until the yellow colour had almost vanished, one drop of starch (7) was introduced on a glass rod and the titration continued with the 0·1, 0·05, and 0·01 cubic centimetre automatic pipettes until the last tint of blue had disappeared.

Tube 1 required 1·4 cubic centimetres of the thiosulphate solution which was equivalent to 1·41 cubic centimetres of N/200 sodium thiosulphate (factor 1·01).

Tube 2 needed 1·4 cubic centimetres of the thiosulphate solution equal to 1·41 N/200.

Tube 3 needed 1·4 cubic centimetres of the thiosulphate solution equal to 1·41 N/200.

Tube 4 needed 1·42 cubic centimetres of the thiosulphate solution equal to 1·43 N/200.

Therefore the mean quantity of N/200 thiosulphate was 1·415 cubic centimetres which is equivalent to 108 milligrammes of dextrose per 100 cubic centimetres. But from this must be deducted the mean sugar value of the blank controls, namely 24 milligrammes, leaving 84 milligrammes per 100 cubic centimetres as the dextrose titre of the blood.

Blank Control Tests.

Four blank control estimations were made in every respect similar to the blood tests, except that the four tubes contained no blood, with these results.

Tube 1 required 1·83 cubic centimetres of thiosulphate equal to 1·85 cubic centimetres of N/200.

Tube 2 required 1·84 cubic centimetres of thiosulphate equal to 1·86 cubic centimetres of N/200.

Tube 3 required 1·84 cubic centimetres of thiosulphate equal to 1·86 cubic centimetres of N/200.

Tube 4 required 1·84 cubic centimetres of thiosulphate equal to 1·86 cubic centimetres of N/200.

The mean quantity of N/200 sodium thiosulphate solution required for the blanks was therefore 1·86 cubic centimetres, which is equal to 24 milligrammes per 100 cubic centimetres when read from the Sugar Conversion Table.

These precautions are essential :—

(1) Cleanliness of test-tubes.

(2) Exact measurements of blood, potassium ferricyanide, potassium iodate, and sodium thiosulphate solutions.

(3) Standardization of the sodium thiosulphate solution before use.

(4) Absolute transparency and freedom from specks in the filtrate after coagulating the proteins.

It is advisable to take the mean of three or four blank experiments and to duplicate the blood tests.

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QUININE PROPHYLAXIS IN NORTHERN INDIA.

By Major T. YOUNG,

Royal Army Medical Corps.

(*Continued from p.* 339.)

Similarly with the Indian troops (*vide* Table VI), out of a total of 2,455 on the quinine roll 854 contracted malaria, a ratio per thousand of 347·86. In the control group of 1,105 there were 591 cases, representing a ratio per thousand of 534·84. The difference in favour of the quinine roll is 186·98 per mille. The estimated saving, calculated by units, as a result of the quinine prophylaxis test is 665 cases of malaria or 44 per cent of the estimated total, i.e., the number which would have occurred had no quinine been given and assuming that the rate which actually prevailed in the control would have occurred among the quinine group. The total admissions from all causes was 1,143 or 465·58 per mille in the quinine roll and 810 or 733·03 per mille in the controls, the admission ratio for all causes other than malaria being 117·72 per mille in the quinine roll, a figure little more than half that in the controls, viz., 198·19 per mille. It is obvious, therefore, that not only did no "masking" or misdiagnoses occur, but that the administration of prophylactic quinine appeared to have a beneficial effect on the general health of these troops. I have often been impressed with this feature in Indian troops. The reduction in admissions to hospital for diseases other than malaria is due, no doubt, to the fact that much of the sickness from which the Indian suffers is indirectly attributable to malaria or at least aggravated by that disease. So well recognized a fact is this that many authorities commence the treatment of pneumonia in Indians by giving an intravenous injection of quinine even though no parasites of malaria have been found in the blood.

I would like to stress the fact that the results given above cover the whole period of the experiment, viz., 95 days, and that quinine was only given for considerably less than half this period, viz., two courses of three weeks each including a rest of one day each week. Comparison of the results obtained during each of the four periods (*vide* Equivalent Annual Ratios in last line of Tables V and VI) shows considerably better results during the periods when quinine was actually being issued, as is to be expected. In the quinine roll (British troops) the equivalent annual ratio of admissions for malaria was 36·7 per mille for the first course and 2461·9 per mille for the second, against 686·0 per mille and 3659·1 per mille respectively for the Controls.

Corresponding figures for Indian troops were 247·7 per mille and 1946.7 per mille for the quinine group and 456·1 per mille and 2611·0 per mille

for the controls. Though these results are perhaps somewhat less dramatic in the case of the Indian troops, the effect of the quinine appears to have been more sustained, for whereas in the case of the British troops the admissions of the two groups for the six weeks period of observation were practically identical, representing equivalent annual ratios of 2627·4 per mille for the quinine roll and 2630·0 per mille for the controls; in the Indian troops the equivalent annual ratios were 1642·5 for the quinine roll and 2831·2 for the controls. This appears to indicate that with the Indian troops the beneficial effect of the quinine continued to be felt long after its administration had ceased.

The figures given for each period do not, of course, convey an exact representation of the results of the quinine administration, for the effect of the quinine was felt for several days after its cessation and the full benefit of its recommencement was likewise not seen for a short period. A reference to the graph (p. 416) bears this out. This graph begins with a low incidence of malaria, the controls suffering somewhat more, and this difference is more marked towards the end of the first course and extending about four days into the interval when the general incidence has begun to rise. During the remainder of the first interval and for about the first three days of the second quinine course the full force of the epidemic began to be felt, and the two curves approximated and rose together. From this point for almost four weeks there was a steady fall in admissions from the quinine roll with no corresponding drop in admissions from the controls, for the first three weeks at any rate.

After a short respite there was in the last few days of October a sharp exacerbation of the epidemic in which the quinine group shared though not to the same extent as the controls. It should be remembered, also, that the rise did not begin till about a week after the quinine had been stopped. In view of this sudden intensification of the epidemic it is unfortunate that the quinine should have been discontinued so early, for there is no doubt that numerous infections continued till at least the end of October. Little would have been lost by commencing the experiment two or three weeks later, say about September 15 or 20, and the test would undoubtedly have been a better one.

Throughout November the sick rate due to malaria was extremely high, but the quinine curve continued to be considerably below the control curve till near the end of the month when the epidemic began to die out and the two curves came down together.

The graph fully bears out the tables showing that throughout all stages of the experiment there was a definitely reduced incidence of malaria and a definitely lower ratio of admissions to hospital for all causes among those taking quinine, and that there was no evidence of "suppression." An examination of the tables reveals that this reduction is shown not only by stations, but by every individual unit, with one small exception, viz.: the first R.A. unit in Table V. The

TABLE VI.—RESULTS OF QUININE PROPHYLAXIS EXPERIMENT. INDIAN TROOPS—

ADMISSIONS FROM QUININE ROLL.

Station and Unit	Strength	1st Course		Interval		2nd Course		Next 6 weeks		TOTAL	
		Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total
PESHAWAR.											
Sikh Regt. ..	135	—	4	—	3	3	18	12	29	15	54
D.T.T. Coy. ..	148	2	8	2	3	4	10	29	34	37	55
Total Peshawar	283	2	12	2	6	7	28	41	63	52	109
Ratio per mille Peshawar		7·07		7·07		34·73		144·87		183·74	385·16
NOWSHERA.											
Distt. Signals	24	—	—	—	—	9	9	5	5	14	14
Mountain Bty.	109	3	5	4	4	11	16	34	41	52	66
Fd. Bty. R.A.	26	—	1	1	1	2	3	4	7	7	12
Fd. Bty. R.A.	38	1	4	—	1	5	6	4	16	10	27
Fd. Bty. R.A.	24	—	2	3	4	1	2	1	3	5	11
F.A.C. ..	32	—	—	1	1	—	1	5	10	6	12
Bombay Pioneers	222	4	9	15	19	41	45	63	69	123	142
Sikh Regt. ..	538	2	6	11	17	28	29	111	132	152	184
Dogra Regt...	350	4	4	10	10	57	64	102	115	173	193
Punjab Regt.	175	3	5	13	14	16	18	19	51	51	88
I.B.T. Coy. ..	198	11	17	11	13	69	74	44	57	135	161
D.T.T. Coy...	113	—	1	6	8	25	25	16	34	47	68
Total Nowshera	1,849	28	54	75	92	264	292	408	540	775	978
Ratio per mille Nowshera		15·14		40·56		142·78		220·66		419·14	528·93
SHAGAI. Landi Kotal from 30.10.29 Raj. Rifles ..	183	3	9	2	4	1	8	11	14	17	35
Ratio per mille		16·39		10·93		5·46		60·11		92·89	191·26
KOHAT DISTRICT. Thal/Hangu from 9.11.29 Punjab Regt.	92	1	2	1	2	—	2	3	6	5	12
Ratio per mille		10·87		10·87				32·61		54·35	130·43
Hangu up to 9.11.29 Jat Regt. ..	48	1	2	—	—	3	5	1	2	5	9
Ratio per mille		20·83				62·50		20·83		104·16	187·50
Grand Total— PESHAWAR AND KOHAT DISTRICTS	2,455	35	79	80	104	275	335	464	625	854	1,143
Ratio per mille		14·25	32·18	32·59	42·36	112·02	136·46	189·00	254·58	347·86	465·58
Equivalent annual ratio per mille		247·7	559·3	1189·4	1546·2	1946·9	2371·7	1642·5	2212·4	1350·7	1807·[illegible]

* N.B. – This is the sum of the estimated savings of each unit and does not agree with the

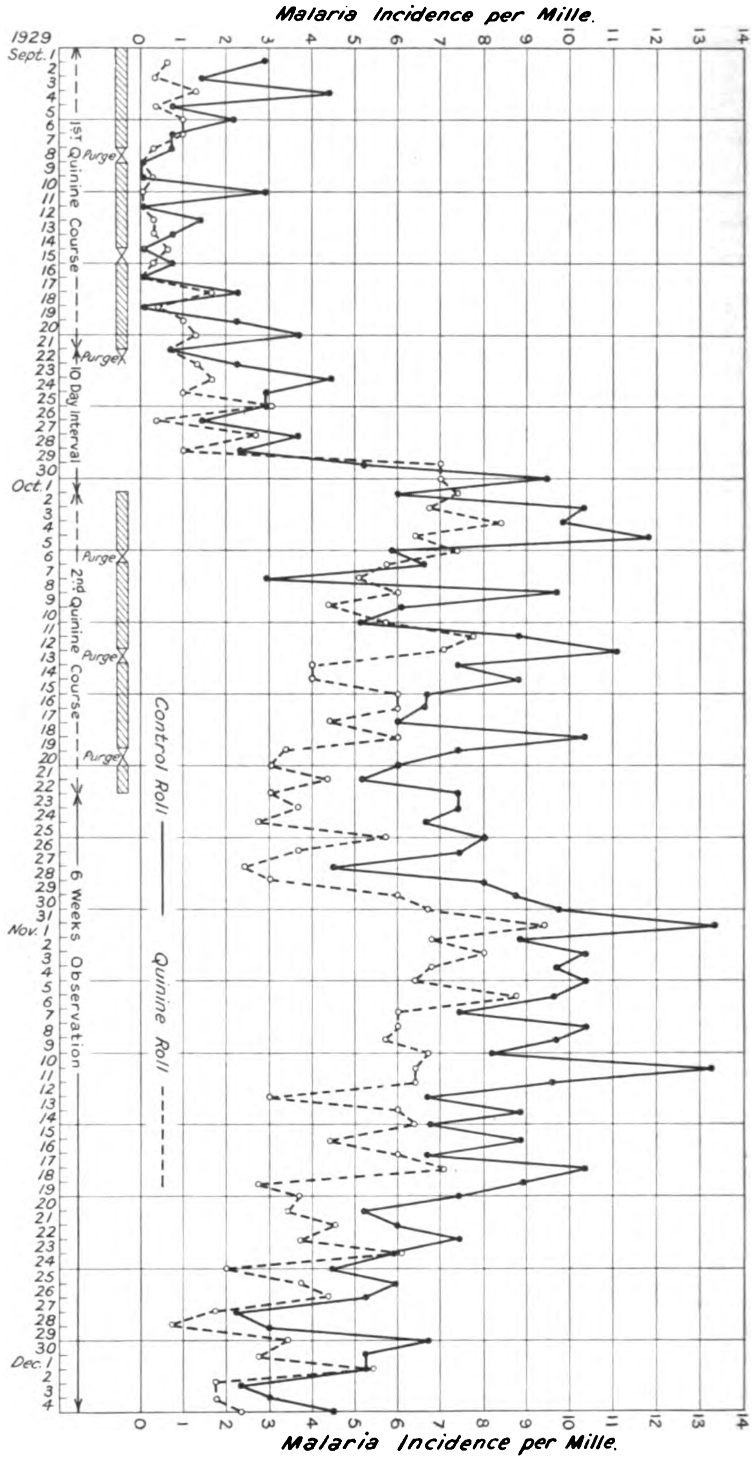
** Calculated on total incidence of all Indian units in Nowshera.

PESHAWAR AND KOHAT DISTRICTS. SEPTEMBER, OCTOBER, NOVEMBER, 1929.

ADMISSIONS FROM CONTROL ROLL.

Strength	1st Course		Interval		2nd Course		Next 6 weeks		TOTAL		Estimated saving of Malaria admissions among quinine roll (Estimate based on rates prevailing among controls)	
	Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total	No.	Percentage
138	1	7	4	4	23	30	21	48	49	89	33	69 %
143	3	6	2	3	23	28	21	23	49	60	14	26 %
281	4	13	6	7	46	58	42	71	98	149	47	47 %
	14·23		21·35		163·70		149·47		348·75	530·25		
9	—	—	—	—	7	8	3	4	10	12	13	48 %
36	1	1	2	3	6	9	26	28	35	41	54	51 %
9	—	—	—	—	2	2	1	4	3	6	2	22 %
13	2	3	—	—	6	6	4	4	12	13	25	71 %
9	1	2	1	1	2	2	1	2	5	7	8	61 %
11	—	—	—	—	2	3	2	5	4	8	6	50 %
79	1	4	4	7	18	22	34	39	57	72	37	23 %
141	1	3	3	4	12	16	61	76	77	99	142	48 %
120	1	2	3	4	21	25	82	88	107	119	139	45 %
55	3	3	5	5	13	20	15	30	36	58	64	56 %
70	3	11	5	7	12	16	43	50	63	84	43	24 %
38	—	3	3	4	11	13	11	25	25	45	27	36 %
590	13	32	26	35	112	142	283	355	434	564	** (585	43 %)
	22·03		44·07		189·83		479·66		735·59	959·53		
93	4	19	—	3	—	7	33	36	37	65	46	63 %
	43·01						354·84		397·85	698·62		
92	2	3	4	4	5	9	1	4	12	20	7	58 %
	21·74		43·48		54·34		10·87		130·43	217·39		
49	6	6	—	2	3	3	1	1	10	12	5	50 %
	122·45				61·22		20·41		204·08	244·89		
1,105	29	73	36	51	166	219	360	467	591	810		
	26·24	66·06	32·58	46·51	150·23	198·19	325·79	422·63	534·84	733·03	665*	44 %
	456·1	1148·2	1189·1	1684·6	2611·0	3444·8	2831·2	3672·9	2076·7	2846·3		

estimated saving worked out on the total incidence of malaria for the whole area.



Malaria Incidence per Mille.
1929
Sept. 1
Oct. 1
Nov. 1
Dec. 1
1st Quinine Course
10 Day Interval
2nd Quinine Course
6 Weeks Observation
Purge
Control Roll ——
Quinine Roll - - - -
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Malaria Incidence per Mille.

incidence in this unit in the six weeks period of observation was greater in the quinine group than in the controls, but this was due not so much to any undue sickness in the quinine group as to an unaccountable freedom from sickness in the control group. A comparison of the sick statistics in the second R.A. Battery and in other units should make this clear.

Effect of Prophylactic Quinine on Subsequent Treatment.

Officers were asked to note whether any difficulty occurred in demonstrating parasites in the blood of cases of malaria which had been receiving prophylactic quinine or whether any effect on treatment was observed. The general opinion was that parasites were quite as easily demonstrated in cases of malaria admitted from the quinine roll as in cases from the control, and that treatment was in no way affected nor the stay in hospital prolonged. These findings were in keeping with my own experience.

More precise work was done in Nowshera, and Colonel James [44] recording his experience the following year (1930) with Indian troops wrote: "Of fever cases which eventually proved to be malaria during the last eight weeks of prophylactic quinine only six out of a total of forty-six were missed at the first blood examination."

During the experiment of 1929 the average stay in hospital of British troops in Nowshera admitted for malaria was 5·90 days for quinine roll, and 5·08 for controls. The duration of fever after admission was also worked out in 100 consecutive cases. For quinine roll cases it was 3·1 days and for controls 3·4. The period after "admission" included any period of "detention" prior to actual admission.

One officer reported that many of his cases of malaria admitted from the quinine roll were afebrile. They complained of malaise, headache, loss of appetite, etc., and it was only when the blood-examination proved positive that a definite diagnosis could be made. These cases rapidly cleared up on quinine.

It would appear, therefore, that prophylactic quinine in no way prejudiced the diagnosis or treatment of intercurrent malaria.

Influence of Temperature.—The experience of the unit stationed at Shagai is of interest. There were 183 on the quinine roll and 93 controls.

Up to the date of departure for Landi Kotal (normal inter-Khyber reliefs) about 10 days after completion of the second quinine course, there had occurred 6 and 5 cases respectively among the quinine and control groups. The day following the arrival of the unit at Landi Kotal a sharp outbreak of malaria began, and the curious feature is that the control group were by far the heaviest sufferers, 32 cases occurring within the next $2\frac{1}{2}$ weeks, a ratio per mille of 344·1, against 10 for the same period in the quinine group, a ratio per mille of 54·6. The only explanation I can offer is the following: During the malaria season at Shagai a large proportion of the troops became infected, but the number of parasites present in the

blood was in most cases insufficient to cause an attack. The fatigue of the march (completed in one day) may have had some effect, but it is thought that the sudden change to the much lower temperature at the higher altitude of Landi Kotal lowered the body resistance and allowed the malaria parasites to get the upper hand. Most of the infections occurring in the quinine group were destroyed as a result of the course of quinine. The infections were not contracted at Landi Kotal for, apart from the fact that malaria cases began the day after arrival in Landi Kotal, units which had been continuously in the station during the malaria season had been practically free from malaria.

Effect of Quinine Prophylaxis on Troops previously free from Infection and on Troops who had been constantly exposed to Malaria.

A brigade of Artillery recently arrived from Jubbulpore consisted partly of seasoned troops, all of whom had spent one season and most many seasons in a malarious cantonment, and partly of a draft from home. The opportunity was taken to observe the results in each group.

The detailed results are given in Table VII. The malaria admissions (both drafts) for the quinine group represented a ratio per mille of 498 as against a similar ratio of 570 for the controls, a difference in favour of the quinine group of 72 per thousand. Corresponding figures for admissions for "allcauses" were 652 (quinine) and 710 (control), the quinine group benefiting to the extent of 58 per thousand.

In both the quinine and control groups a higher admission ratio is observed in the Jubbulpore draft. The difference is more marked in the controls, viz., 94 per thousand. In the quinine group the difference is 69 per thousand. Again in the Jubbulpore group the incidence in the quinine roll is 538 per mille and in the controls 608, a difference of 68 per thousand. Similar figures for the United Kingdom draft were 469 (quinine) and 512 (control), the difference being only 43 per thousand.

These results, though the extent of the experiment was small, appear to indicate that malaria was more prevalent among the "old stagers" presumably owing to relapses of old infections, and that the "old stagers" also benefited from the quinine to a somewhat greater extent than the new arrivals. This was in all likelihood due to the fact that the courses of quinine assisted in clearing up old standing infections.

Cost of Quinine Prophylaxis.

To work out the net cost of the whole experiment would involve a large amount of clerical labour. We may take, however, the Indian troops in Nowshera as an example (*vide* Table VI) :—

(*a*) 1,849 men were given 360 grains of quinine sulphate each (if they lasted the course).

The cost at Rs. 18/- per lb. was Rs. 1,710/-.

This is less than one rupee per man.

TABLE VII.—QUININE PROPHYLAXIS EXPERIMENT.

Summary of admissions for "Malaria" and for "All Causes" in drafts from U.K. and Jubbulpore to determine the relative effect of quinine prophylaxis on troops previously free from infection and troops who had been constantly exposed.

Unit	Quinine Group							Control Group						
	Jubbulpore Draft		U.K. Draft		Total			Jubbulpore Draft		U.K. Draft		Total		
	Strength	Malaria admissions	Strength	Malaria admissions	Strength	Malaria admissions	All Causes	Strength	Malaria admissions	Strength	Malaria admissions	Strength	Malaria admissions	All Causes
—/— Field Battery	45	25	48	27	93	52 (538 ‰)	69 (742 ‰)	17	15	23	9	40	24 (600 ‰)	25 (625 ‰)
— — — Field Battery ..	33	16	49	22	82	38 (464 ‰)	49 (598 ‰)	23	8	9	8	32	16 (500 ‰)	26 (813 ‰)
— • — Field Battery	26	15	46	18	72	33 (458 ‰)	43 (597 ‰)	26	17	9	4	35	21 (600 ‰)	25 (714 ‰)
Totals	104	56	143	67	247	123	161	66	40	41	21	107	61	76
Ratios per mille		538 ‰		469 ‰		498 ‰	652 ‰		606 ‰		512 ‰		570 ‰	710 ‰

NOTE I. As is to be expected, the Jubbulpore Draft, previously heavily infected, showed a higher incidence of malaria admissions than the draft from U.K.

II. Both drafts appeared to share, the Jubbulpore Draft to a somewhat greater extent, the benefits of quinine prophylaxis, though the beneficial effect in R.A. units appears to be much less marked than in Infantry units.

Several reasons may be advanced in explanation, e.g. (a) Ordinary barrack room discipline is generally not so good in R.A. units.

(b) Gunners are harder worked.

(c) Gunners during "stables" are exposed to bites by mosquitoes which harbour in the lines and fodder sheds.

reduction of the ferricyanide. The dextrose in the blood tubes will be increased in like amount, so that the difference between the sugar values of the blood tubes and the blanks remains unaffected by the slight deviation from N/200 of the ferricyanide solution.

Blood Tests.

0·4 cubic centimetre of blood was taken from a finger-prick, and was mixed with 20 cubic centimetres of freshly prepared 0·45 per cent zinc sulphate and 4 cubic centimetres of N/10 sodium hydrate solution (2). The tube was placed in boiling water for three minutes and the liquid was filtered while hot through a small plug of boiled cotton wool. The filtrate was crystal-clear. The filter was washed with 12 cubic centimetres of distilled water twice, and 8 cubic centimetres of the potassium ferricyanide reagent (3) were added and the whole was evenly divided in four test-tubes, so that each tube contained 0·1 cubic centimetre of blood and 2 cubic centimetres of potassium ferricyanide solution. The tubes were placed in a boiling water bath for fifteen minutes, cooled under the tap, and to each 3 cubic centimetres of the zinc sulphate-iodide solution (4) and 2 cubic centimetres of acetic acid (5) were added. Titration with the sodium thiosulphate solution was begun with the 1 cubic centimetre pipette and continued until the yellow colour had almost vanished, one drop of starch (7) was introduced on a glass rod and the titration continued with the 0·1, 0·05, and 0·01 cubic centimetre automatic pipettes until the last tint of blue had disappeared.

Tube 1 required 1·4 cubic centimetres of the thiosulphate solution which was equivalent to 1·41 cubic centimetres of N/200 sodium thiosulphate (factor 1·01).

Tube 2 needed 1·4 cubic centimetres of the thiosulphate solution equal to 1·41 N/200.

Tube 3 needed 1·4 cubic centimetres of the thiosulphate solution equal to 1·41 N/200.

Tube 4 needed 1·42 cubic centimetres of the thiosulphate solution equal to 1·43 N/200.

Therefore the mean quantity of N/200 thiosulphate was 1·415 cubic centimetres which is equivalent to 108 milligrammes of dextrose per 100 cubic centimetres. But from this must be deducted the mean sugar value of the blank controls, namely 24 milligrammes, leaving 84 milligrammes per 100 cubic centimetres as the dextrose titre of the blood.

Blank Control Tests.

Four blank control estimations were made in every respect similar to the blood tests, except that the four tubes contained no blood, with these results.

Tube 1 required 1·83 cubic centimetres of thiosulphate equal to 1·85 cubic centimetres of N/200.

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The mean quantity of N/200 sodium thiosulphate solution required for the blanks was therefore 1·86 cubic centimetres, which is equal to 24 milligrammes per 100 cubic centimetres when read from the Sugar Conversion Table.

These precautions are essential :—

(1) Cleanliness of test-tubes.

(2) Exact measurements of blood, potassium ferricyanide, potassium iodate, and sodium thiosulphate solutions.

(3) Standardization of the sodium thiosulphate solution before use.

(4) Absolute transparency and freedom from specks in the filtrate after coagulating the proteins.

It is advisable to take the mean of three or four blank experiments and to duplicate the blood tests.

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The usual procedure [2] is to administer fifty grammes of dextrose in three or four hundred cubic centimetres of water and to determine the blood-sugar in five samples of blood taken at half-hourly intervals, one before and four after the dextrose drink.

MILLIGRAMMES OF DEXTROSE PER 100 CUBIC CENTIMETRES OF BLOOD.

	Before	½ hour after	1 hour after	1½ hours after	2 hours after
Normal	100	120	130	110	100
Lag curve	100	150	230	140	120
Mild diabetes	170	187	198	190	182
Severe diabetes	240	270	294	300	314
Renal glycosuria	98	100	94	96	98

Leak point of kidney 180.

Until the clinical importance of blood-sugar values was apparent, biochemists generally made use of five cubic centimetres of blood drawn from a vein for their tests, but on the need arising of repeated examinations, search was made for micro-chemical methods which would require 0·1 cubic centimetre of blood only, such as may be obtained from a finger-prick. Bang originated a process of this kind and about a dozen modifications of his have been introduced. They involved the use of expensive apparatus, platinum crucibles, micro-balances, tintometers, colorimeters, centrifuges, etc., and were not free from defects. It was the object of the writer to ascertain if reliable quantitative blood-sugar tests could be made with laboratory equipment of quite modest proportions.

In the year 1859 Gentele [3] discovered a method of dextrose estimation by means of potassium ferricyanide in alkaline solution, which is quantitatively reduced by dextrose. He found [4] that urea, uric acid, and ammonia and its salts, caused a similar reduction, hence the reagent was worthless for urine analysis. The process, therefore, was lost sight of by biochemists until revived and elaborated by Hagedorn and Jensen [5] for the micro-chemical estimation of blood-sugar after many futile experiments with dyes, etc.

Their paper appeared in the year 1923. Dr. G. Graham, Assistant Physician of St. Bartholomew's Hospital, described Hagedorn and Jensen's test in the second edition of his "Pathology and Treatment of Diabetes Mellitus," 1926, where he states that he has adopted it in place of Bang's which he had used before. Duggan and Scott [6] obtained accurate results with Hagedorn's test over a range of 23 to 200 milligrammes dextrose per 100 cubic centimetres of blood. Citron [7], who had worked with Bang's micro-test for two years, obtained much better results with Hagedorn's. Pucher and Finch [8] investigated the comparative merits of the various micro-methods. Hagedorn's gave more uniform and consistent results than the others. Hanes [9] has modified the process for the estimation of larger quantities of dextrose. Kramer and Steiner [10] secured reliable readings

up to 350 milligrammes per 100 cubic centimetres of blood by adding known quantities of dextrose. They gave a table from which a graph could be drawn which is nearly a straight line. Hulme and Narain [11] also find that a linear relation exists between the dextrose and ferricyanide reduced over a range of 20 to 300 milligrammes of dextrose per 100 cubic centimetres. G. A. Harrison [12] gives a full account of the manner of carrying out the test and the interpretation to be put on blood sugar curves. Professor M. Jacobi [13] of Berlin, notes the advantages of Hagedorn's over other micro-tests. Worsley and Nutman [14] use Hagedorn's process for the determination of sugar in the vegetable kingdom. In common with most observers they remark that the figures become less consistent when the dextrose exceeds 300 milligrammes per 100 cubic centimetres. Peters and Van Slyke [15] state that Hagedorn's test is so convenient that it has been almost universally adopted throughout Europe. Formiguera [16] prefers it to all others. Widdowson [17] also has made exhaustive studies of the method.

The subject has engaged the attention of the writer for two years, during which he has carried out more than 1,400 titrations in connection with Hagedorn's test. He has worked with known dilutions of dextrose, and with 289 samples of normal blood, diabetic blood and with blood to which measured amounts of dextrose have been added. He has convinced himself of the reliability of the method, and of the ease with which it can be performed with but little apparatus. Indeed, some diabetics, who are all now taught to use Benedict's qualitative test daily, have learnt how to measure their blood sugar in this manner.

Since a description of Hagedorn and Jensen's test is not included in some of the recent works on clinical pathology and laboratory methods, it is hoped that the minute details given here may be of use to those called upon to treat diabetes, who may be far removed from a biochemical laboratory or medical library, and are concerned that their patients shall not suffer thereby.

Dextrose disappears rapidly from blood *in vitro* [18, 19, 20], therefore there should be no delay in the examination. Glycolysis also occurs in oxalated blood [21]. Fluorides tend to arrest it [22]. Graham [23] adds 0·02 gramme of a mixture of four parts of potassium oxalate and one of potassium fluoride to 5 cubic centimetres of blood. Lax and Szunat [24], and Ewing [25] state that the addition of 1 per cent sodium fluoride and 0·1 per cent mercuric chloride preserves the dextrose in the blood. Ionescu-Matiu [26] adds 0·4 per cent sodium fluoride to the blood. Rose and Schattner [27] fuse together 15 grammes of sodium sulphate and 0·2 gramme of sodium fluoride, and the powdered result is intimately mixed with 0·1 cubic centimetre of blood. This treatment with fluorides generally hinders glycolysis, but sometimes fails notably. Hence to prevent such avoidable errors, the tests should be begun immediately after withdrawing the blood.

If familiar with Sir Almroth Wright's technique of rubber teat and

pipette, no difficulty will be experienced in making the exact measurements required. Automatic pipettes delivering 0·1, 0·05, and 0·01 cubic centimetre are made [28], and their accuracy is proved by ascertaining that ten, twenty and a hundred times their measure of mercury respectively weigh exactly 13·56 grammes, which is the weight of 1 cubic centimetre of mercury at 15° C. This can be weighed in dispensing grain scales sensitive to a centigramme. The 1 cubic centimetre pipette should be checked in like manner. A 10 cubic centimetre and a 100 cubic centimetre glass measure and a Liebig's glass condenser for distilling water are necessary.

The following "Analytical Reagents" in approximate quantities must be procured from a reliable source and guaranteed "AR."

Potassium ferricyanide, free from ferrocyanide ..	25	grammes
Sodium carbonate, anhydrous, free from Fe	250	,,
Zinc sulphate ,, ,, ...	500	,,
Sodium hydrate ,, ,, ...	100	,,
Sodium chloride ,, ,, ...	500	,,
Sodium thiosulphate ,, ,, ...	250	,,
Potassium iodate ,, ,, ...	25	,,
Potassium iodide ,, ,, ...	100	,,
Glacial acetic acid ,, ,, ...	100	,,
Starch, ordinary	100	,,
Dextrose, pure A. R.	100	,,

The solutions required are :—

(1) Zinc sulphate 45 grammes dissolved in distilled water and made up to 100 cubic centimetres.

(2) Sodium hydrate, decinormal, 0·4 gramme to 100 cubic centimetres distilled water. This must be renewed weekly.

(3) Potassium ferricyanide, N/200, 1·65 gramme to the litre, and sodium carbonate N/5, or 10·6 grammes to the litre. Since this solution deteriorates after some weeks, it is advisable to make this smaller quantity, which is more convenient for weighing :—

Potassium ferricyanide		0·4 gramme
Sodium carbonate, anhydrous		2·58 grammes
Distilled water	to	242·42 cubic centimetres.

The ferricyanide must be weighed and the solution measured with great accuracy. Exposure to light damages this reagent. Two cubic centimetres need 2 cubic centimetres of N/200 sodium thiosulphate solution to discharge the colour after adding 3 cubic centimetres of solution (4) and 2 cubic centimetres of solution (5).

(4)	Zinc sulphate	10 grammes
	Sodium chloride	50 ,,
	Distilled water	200 cubic centimetres.

To 40 cubic centimetres of this 1 gramme of potassium iodide is added as wanted, since the iodide is not stable when thus dissolved.

(5) Acetic acid 3 per cent dilution in distilled water.

(6)	N/10 Sodium thiosulphate	2·48 grammes
	Distilled water .. .. .. to	100 cubic centimetres.

N/200 sodium thiosulphate is prepared from this by diluting twenty times. This dilution must be titrated with the potassium iodate before use.

(7) Starch one gramme is mixed with 20 cubic centimetres of cold distilled water and washed into 60 cubic centimetres of boiling distilled water, boiled for two minutes, 20 grammes of sodium chloride added, and made up to 100 cubic centimetres with distilled water. Thus prepared it remains serviceable for months.

(8) Potassium iodate, Molar/1200 or 0·1783 gramme to the litre. To prepare this, make a M/120 solution by dissolving

Potassium iodate	0·2 gramme
Distilled water	112·14 cubic centimetres.

This must be done with great accuracy.

One part of the M/120 solution is made up to ten parts with distilled water at intervals of a week. Although Hagedorn states that the M/1200 dilution is absolutely stable, "unbedingt haltbar," moulds may be found in it after the lapse of weeks, which reduce its strength.

Potassium ferricyanide, $K_3Fe(CN)_6$, is reduced by dextrose in alkaline solution to potassium ferrocyanide, $K_4Fe(CN)_6$; the amount of the ferricyanide which remains unreduced is found by converting it into ferrocyanide with potassium iodide and acetic acid, by which iodine is set free, according to the equation, $2K_3\,Fe(CN)_6 + 2KI = 2K_4Fe(CN)_6 + I_2$. The iodine is then estimated by titrating with sodium thiosulphate, with starch as an indicator:—

$$2Na_2S_2O_3 + I_2 = 2NaI + Na_2S_4O_6$$

Thus we learn the amount of ferricyanide which was not reduced by the dextrose, and knowing the total quantity of ferricyanide which was present originally, the difference gives the amount of ferricyanide reduced by the dextrose.

The reaction of the ferricyanide with the iodide is reversible, so it is necessary to remove the ferrocyanide as soon as it is formed, by means of zinc sulphate in excess with which it yields a very insoluble compound, zinc potassium ferrocyanide,

$$2K_4Fe(CN)_6 + 3ZnSO_4 = K_2Zn_3(Fe(CN)_6)_2$$

To carry out the test, the proteins of the blood must be removed. This is effected by heating with zinc hydrate.

Five cubic centimetres of a 0·45 per cent zinc sulphate solution are prepared by measuring 0·05 cubic centimetre of the 0·45 per cent zinc sulphate solution and making it up to 5 cubic centimetres with distilled water. One cubic centimetre of the N/10 sodium hydrate solution is added, whereby a flocculent precipitate is produced. Both the 0·45 per cent zinc sulphate and the N/10 sodium hydrate must be freshly prepared.

From a finger prick 0·1 cubic centimetre of blood is measured exactly with a verified pipette, or often it is easier to take two measures of 0·05 cubic centimetre each, which are drops of large size, while 0·1 cubic centimetre may run down the finger. The blood is added to the zinc hydrate,

and the pipette washed with the fluid. The test-tube containing the mixture is placed in boiling water for three minutes. Clots form leaving the liquid clear. Filter while hot through a small plug of cotton-wool which has been boiled and dried. The wool should not be compressed too tightly. The protein clot which collects on the surface forms a most efficient filter. The result is a crystal-clear filtrate. If there is the least trace of opalescence in it, it must be passed through the filter again, for this haze indicates the presence of protein, which even in infinitesimal amount quite vitiates the results. The test-tube and filter are then washed with 3 cubic centimetres of distilled water twice. Add 2 cubic centimetres of the potassium ferricyanide reagent (3), measured with the utmost exactness, and place the tube in a boiling-water bath for fifteen minutes. Cool under the water-tap, and add 3 cubic centimetres of the iodide-zinc solution (4) and 2 cubic centimetres of the 3 per cent acetic acid (5); not so great accuracy is required for these last two measurements, since the reagents entering into the reaction are in great excess. The fluid is now yellow from the setting free of iodine. N/200 sodium thiosulphate solution is added slowly and carefully with the 1 cubic centimetre pipette until a trace only of the yellow colour remains. With a glass rod one drop of the starch solution (7) is added, which gives a blue tint immediately. The titration is continued with the 0·1, 0·05, and 0·01 cubic centimetre pipettes until the colour is discharged. The end-point is sharp and occurs after the addition of 0·01 cubic centimetre of N/200 thiosulphate, which represents 1·9 millionths of a gramme of dextrose only. It is evident, therefore, that the test is one of extreme delicacy, and herein lies the absolute necessity of scrupulous cleanliness of test-tubes. The merest trace of protein left in a tube after coagulating the blood will give rise to large errors. Hence avoid the tubes used for this purpose. The amount of dextrose in 0·1 cubic centimetre of normal blood varies from 80 to 150 millionths of a gramme. The limits of the experimental errors which may arise are thus about thirty times less than the range of fluctuations of the dextrose in normal blood. The dextrose-content of the blood in milligrammes per 100 cubic centimetres, corresponding to the number of cubic centimetres of N/200 sodium thiosulphate used, is read from the Sugar Conversion Table.

It is necessary to carry out blank control experiments in every case, in all respects similar to that described, except that there is no blood added to the reagents, for ferricyanide solutions undergo some spontaneous reduction on heating for fifteen minutes. The dextrose corresponding to the number of cubic centimetres of N/200 thiosulphate used in this blank test is subtracted from that found in the blood-test. The difference gives the number of milligrammes of dextrose in 100 cubic centimetres of blood. The titration should not be delayed after adding the iodide zinc solution, for Widdowson [17] has found that when the tubes were allowed to stand at room temperature for ten minutes, there was a loss of iodine equivalent to 0·01 cubic centimetre of N/200 thiosulphate; and after an hour a loss

equal to 0·08 cubic centimetre of N/200. If the tubes were kept on ice none of the iodine escaped. Formiguera [16] has confirmed these observations.

The N/200 sodium thiosulphate solution is very unstable, and is no longer N/200 after one or two days. Its titre must always be ascertained before use by titrating the M/1200 potassium iodate solution with it, 1 cubic centimetre of which is exactly equal to 1 cubic centimetre of N/200 thiosulphate. For this purpose 2 cubic centimetres of the M/1200 potassium iodate solution are measured very carefully, 3 cubic centimetres of the iodide-zinc solution are added and 2 cubic centimetres of 3 per cent acetic acid. This reaction then takes place:

$$KIO_3 + 5KI + 6CH_3COOH = 3I_2 + 6CH_3COOK + 3H_2O.$$

The thiosulphate solution to be tested is then added to the mixture slowly and carefully with the 1 cubic centimetre pipette until the yellow tint has almost disappeared, a drop of starch added, and the titration completed with the 0·1, 0·05 and 0·01 cubic centimetre pipettes. It will be but seldom that exactly 2 cubic centimetres of the thiosulphate solution

SUGAR CONVERSION TABLE.

MILLIGRAMMES OF DEXTROSE PER 100 CUBIC CENTIMETRES OF BLOOD.

Sodium thiosulphate N/200	0	1	2	3	4	5	6	7	8	9
c.c.										
0·0	385	383	381	379	377	375	373	371	369	367
0·1	365	362	360	358	356	354	352	350	348	346
0·2	344	342	340	338	336	333	331	329	327	325
0·3	323	320	318	316	314	312	310	308	306	305
0·4	303	301	299	297	294	292	290	288	286	284
0·5	282	280	278	276	274	272	270	268	266	264
0·6	262	260	258	256	254	253	251	249	247	245
0·7	243	241	239	237	235	233	231	229	227	225
0·8	223	221	219	217	215	213	211	209	207	205
0·9	203	201	199	197	195	193	192	190	188	186
1·0	184	182	180	179	177	175	173	171	169	167
1·1	165	163	161	160	158	156	154	152	150	148
1·2	146	144	142	141	139	137	135	134	132	130
1·3	128	126	124	123	121	120	118	116	114	112
1·4	110	109	107	105	103	102	100	98	96	94
1·5	92	90	88	86	84	82	80	78	76	74
1·6	72	71	69	67	65	63	61	60	58	56
1·7	54	52	51	49	47	45	43	41	39	37
1·8	35	34	32	30	28	26	24	22	20	18
1·9	16	14	12	10	8	7	5	4	3	2

is the amount necessary to discharge the blue tint in 2 cubic centimetres of the M/1200 potassium iodate solution. For instance, 2·2 cubic centimetres of the thiosulphate may be required. This means that the number of cubic centimetres of thiosulphate solution used must be diminished in the proportion of 2 to 2·2, by multiplying by the factor 2/2·2, or 0·91, in order to obtain the equivalent amount of N/200 sodium thiosulphate solution. A slide rule enables this to be done rapidly.

In the writer's experiments, a fresh solution of pure dextrose was made

by dissolving 1 gramme in 1,000 cubic centimetres of tap-water; 0·1, 0·2 and 0·3 cubic centimetre of which were tested in a manner similar to 0·1 cubic centimetre of blood, representing 100, 200 and 300 milligrammes of dextrose respectively in 100 cubic centimetres.

In 379 tests with 0·1 cubic centimetre of the 1 in 1,000 dextrose dilution, the mean difference of the number of cubic centimetres of N/200 thiosulphate solution required for the blank and the test respectively was 0·54 cubic centimetre, corresponding to the number 2—0·54, or 1·46 cubic centimetres, in the Sugar Conversion Table. This equals 95 milligrammes per 100 cubic centimetres in Hagedorn's Table, but it is equivalent to 102 milligrammes per 100 cubic centimetres when read from a large scale graph based on Kramer and Steiner's figures.

In 218 tests with 0·2 cubic centimetre of the dextrose dilution, the mean difference between blank and test was 1·0829 cubic centimetre of N/200 thiosulphate, corresponding to the number 2—1·0829 or 0·9171 cubic centimetre N/200 thiosulphate in the Sugar Conversion Table, which is equal to 192 milligrammes per 100 cubic centimetres according to Hagedorn, and 202 milligrammes per 100 cubic centimetres by Kramer's graph.

In 107 tests with 0·3 cubic centimetre of the 1 in 1,000 dextrose solution, the mean difference between the blank and test was 1·582 cubic centimetres N/200 thiosulphate solution, corresponding to the number 2—1·582 or 0·418 cubic centimetre of N/200 thiosulphate in the Sugar Conversion Table, equal to 287 milligrammes per 100 cubic centimetres by Hagedorn, and 297 milligrammes by Kramer. The writer's results, therefore, approximate more closely to Kramer and Steiner's observations than to Hagedorn's, and his Sugar Conversion Table is compiled from the readings of a large scale graph based on the values he obtained.

On plotting Hagedorn's figures of his Sugar Conversion Table, it is seen that they, like Kramer's and the writer's, lie in a nearly straight line, but somewhat below both of these. Hagedorn gave an empirical equation for calculating the dextrose values corresponding to the potassium ferricyanide reduced, and a table of figures which, he thought, erroneously, verified it. For on substituting one set of the values given in his table, in the equation, the other set obtained by solving the equation do not agree with his data. This is not surprising, for his equation is not that of a straight line, but is that of a parabola.

If more than 300 milligrammes of dextrose per 100 cubic centimetres be present, the scatter of the deviations in such tests is greater than in those under that amount. This, too, has been noted by several observers. Hence more reliable determinations can be made by employing 0·05 cubic centimetre of blood only, instead of 0·1 cubic centimetre, when testing the blood of those suffering from severe diabetes.

Still more decisive experiments on the efficiency of the ferricyanide process were made by taking 0·2 cubic centimetre of normal blood,

estimating the dextrose in 0·1 cubic centimetre, and to the remaining 0·1 cubic centimetre adding 0·1 cubic centimetre of a freshly prepared 1 in 1,000 dextrose solution, equivalent to the addition of 100 milligrammes of dextrose per 100 cubic centimetres of blood, before determining the sugar content. This was done in 69 instances. In 20 of these the exact amount of 100 milligrammes was recovered. The mean value obtained in the 69 experiments was 98·23 milligrammes per 100 cubic centimetres with a standard deviation of 4·38, which gives a probable error of $\pm$ 2·95. Hence the result may be thus expressed: $98{\cdot}23 \pm 2{\cdot}95$ milligrammes of dextrose per 100 cubic centimetres of blood were recovered out of the 100 milligrammes introduced. Naumann's [29] probable error of his blood-sugar values obtained by the ferricyanide process was $\pm$ 4 per cent. The method, therefore, is trustworthy.

As an example of the routine of a blood examination, and of the degree of consistency attained in parallel experiments, the following, the last undertaken, may be quoted.

Sodium Thiosulphate Solution Titration.

To 2 cubic centimetres of M/1200 potassium iodate solution (8) 3 cubic centimetres of the zinc-iodide reagent (4) and 2 cubic centimetres of 3 per cent acetic acid (5) were added. The titration was begun by adding exactly 1·9 cubic centimetres of the thiosulphate solution under investigation, which discharged all but a trace of yellow. The mixture was then stirred with a glass rod which had been dipped in the starch solution, and the titration was continued with the 0·05 cubic centimetre and 0·01 cubic centimetre automatic pipettes. 1·99 cubic centimetres of the thiosulphate were required in all to remove the last trace of blue.

A duplicate test gave 1·98 cubic centimetres as the result
A triplicate ,, ,, 1·97 ,, ,, ,,

The mean then is 1·98 cubic centimetres and the thiosulphate factor is 2/1·98 or 1·01.

Potassium Ferricyanide Solution Titration.

To 2 cubic centimetres of the potassium ferricyanide solution (3) 3 cubic centimetres of the zinc-iodide solution (4) and 2 cubic centimetres of acetic acid (5) were added and titration with the thiosulphate solution was carried out in a similar manner as above. 1·88 cubic centimetres of the thiosulphate solution were required. This number multiplied by the factor 1·01 gives 1·90 which is the quantity of N/200 sodium thiosulphate needed to neutralize the potassium ferricyanide present.

A duplicate test gave 1·92 cubic centimetres of N/200 as the result. No error will arise on account of the ferricyanide solution not being exactly N/200; since the effect of the deficiency in the potassium ferricyanide appears in the smaller amount of N/200 sodium thiosulphate being required in the blank controls. This lessened quantity of thiosulphate when converted into its sugar value indicates apparently a greater degree of self-

reduction of the ferricyanide. The dextrose in the blood tubes will be increased in like amount, so that the difference between the sugar values of the blood tubes and the blanks remains unaffected by the slight deviation from N/200 of the ferricyanide solution.

Blood Tests.

0·4 cubic centimetre of blood was taken from a finger-prick, and was mixed with 20 cubic centimetres of freshly prepared 0·45 per cent zinc sulphate and 4 cubic centimetres of N/10 sodium hydrate solution (2). The tube was placed in boiling water for three minutes and the liquid was filtered while hot through a small plug of boiled cotton wool. The filtrate was crystal-clear. The filter was washed with 12 cubic centimetres of distilled water twice, and 8 cubic centimetres of the potassium ferricyanide reagent (3) were added and the whole was evenly divided in four test-tubes, so that each tube contained 0·1 cubic centimetre of blood and 2 cubic centimetres of potassium ferricyanide solution. The tubes were placed in a boiling water bath for fifteen minutes, cooled under the tap, and to each 3 cubic centimetres of the zinc sulphate-iodide solution (4) and 2 cubic centimetres of acetic acid (5) were added. Titration with the sodium thiosulphate solution was begun with the 1 cubic centimetre pipette and continued until the yellow colour had almost vanished, one drop of starch (7) was introduced on a glass rod and the titration continued with the 0·1, 0·05, and 0·01 cubic centimetre automatic pipettes until the last tint of blue had disappeared.

Tube 1 required 1·4 cubic centimetres of the thiosulphate solution which was equivalent to 1·41 cubic centimetres of N/200 sodium thiosulphate (factor 1·01).

Tube 2 needed 1·4 cubic centimetres of the thiosulphate solution equal to 1·41 N/200.

Tube 3 needed 1·4 cubic centimetres of the thiosulphate solution equal to 1·41 N/200.

Tube 4 needed 1·42 cubic centimetres of the thiosulphate solution equal to 1·43 N/200.

Therefore the mean quantity of N/200 thiosulphate was 1·415 cubic centimetres which is equivalent to 108 milligrammes of dextrose per 100 cubic centimetres. But from this must be deducted the mean sugar value of the blank controls, namely 24 milligrammes, leaving 84 milligrammes per 100 cubic centimetres as the dextrose titre of the blood.

Blank Control Tests.

Four blank control estimations were made in every respect similar to the blood tests, except that the four tubes contained no blood, with these results.

Tube 1 required 1·83 cubic centimetres of thiosulphate equal to 1·85 cubic centimetres of N/200.

Tube 2 required 1·84 cubic centimetres of thiosulphate equal to 1·86 cubic centimetres of N/200.

Tube 3 required 1·84 cubic centimetres of thiosulphate equal to 1·86 cubic centimetres of N/200.

Tube 4 required 1·84 cubic centimetres of thiosulphate equal to 1·86 cubic centimetres of N/200.

The mean quantity of N/200 sodium thiosulphate solution required for the blanks was therefore 1·86 cubic centimetres, which is equal to 24 milligrammes per 100 cubic centimetres when read from the Sugar Conversion Table.

These precautions are essential :—

(1) Cleanliness of test-tubes.

(2) Exact measurements of blood, potassium ferricyanide, potassium iodate, and sodium thiosulphate solutions.

(3) Standardization of the sodium thiosulphate solution before use.

(4) Absolute transparency and freedom from specks in the filtrate after coagulating the proteins.

It is advisable to take the mean of three or four blank experiments and to duplicate the blood tests.

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QUININE PROPHYLAXIS IN NORTHERN INDIA.

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(*Continued from p.* 339.)

Similarly with the Indian troops (*vide* Table VI), out of a total of 2,455 on the quinine roll 854 contracted malaria, a ratio per thousand of 347·86. In the control group of 1,105 there were 591 cases, representing a ratio per thousand of 534·84. The difference in favour of the quinine roll is 186·98 per mille. The estimated saving, calculated by units, as a result of the quinine prophylaxis test is 665 cases of malaria or 44 per cent of the estimated total, i.e., the number which would have occurred had no quinine been given and assuming that the rate which actually prevailed in the control would have occurred among the quinine group. The total admissions from all causes was 1,143 or 465·58 per mille in the quinine roll and 810 or 733·03 per mille in the controls, the admission ratio for all causes other than malaria being 117·72 per mille in the quinine roll, a figure little more than half that in the controls, viz., 198·19 per mille. It is obvious, therefore, that not only did no "masking" or misdiagnoses occur, but that the administration of prophylactic quinine appeared to have a beneficial effect on the general health of these troops. I have often been impressed with this feature in Indian troops. The reduction in admissions to hospital for diseases other than malaria is due, no doubt, to the fact that much of the sickness from which the Indian suffers is indirectly attributable to malaria or at least aggravated by that disease. So well recognized a fact is this that many authorities commence the treatment of pneumonia in Indians by giving an intravenous injection of quinine even though no parasites of malaria have been found in the blood.

I would like to stress the fact that the results given above cover the whole period of the experiment, viz., 95 days, and that quinine was only given for considerably less than half this period, viz., two courses of three weeks each including a rest of one day each week. Comparison of the results obtained during each of the four periods (*vide* Equivalent Annual Ratios in last line of Tables V and VI) shows considerably better results during the periods when quinine was actually being issued, as is to be expected. In the quinine roll (British troops) the equivalent annual ratio of admissions for malaria was 36·7 per mille for the first course and 2461·9 per mille for the second, against 686·0 per mille and 3659·1 per mille respectively for the Controls.

Corresponding figures for Indian troops were 247·7 per mille and 1946.7 per mille for the quinine group and 456·1 per mille and 2611·0 per mille

for the controls. Though these results are perhaps somewhat less dramatic in the case of the Indian troops, the effect of the quinine appears to have been more sustained, for whereas in the case of the British troops the admissions of the two groups for the six weeks period of observation were practically identical, representing equivalent annual ratios of 2627·4 per mille for the quinine roll and 2630·0 per mille for the controls; in the Indian troops the equivalent annual ratios were 1642·5 for the quinine roll and 2831·2 for the controls. This appears to indicate that with the Indian troops the beneficial effect of the quinine continued to be felt long after its administration had ceased.

The figures given for each period do not, of course, convey an exact representation of the results of the quinine administration, for the effect of the quinine was felt for several days after its cessation and the full benefit of its recommencement was likewise not seen for a short period. A reference to the graph (p. 416) bears this out. This graph begins with a low incidence of malaria, the controls suffering somewhat more, and this difference is more marked towards the end of the first course and extending about four days into the interval when the general incidence has begun to rise. During the remainder of the first interval and for about the first three days of the second quinine course the full force of the epidemic began to be felt, and the two curves approximated and rose together. From this point for almost four weeks there was a steady fall in admissions from the quinine roll with no corresponding drop in admissions from the controls, for the first three weeks at any rate.

After a short respite there was in the last few days of October a sharp exacerbation of the epidemic in which the quinine group shared though not to the same extent as the controls. It should be remembered, also, that the rise did not begin till about a week after the quinine had been stopped. In view of this sudden intensification of the epidemic it is unfortunate that the quinine should have been discontinued so early, for there is no doubt that numerous infections continued till at least the end of October. Little would have been lost by commencing the experiment two or three weeks later, say about September 15 or 20, and the test would undoubtedly have been a better one.

Throughout November the sick rate due to malaria was extremely high, but the quinine curve continued to be considerably below the control curve till near the end of the month when the epidemic began to die out and the two curves came down together.

The graph fully bears out the tables showing that throughout all stages of the experiment there was a definitely reduced incidence of malaria and a definitely lower ratio of admissions to hospital for all causes among those taking quinine, and that there was no evidence of "suppression." An examination of the tables reveals that this reduction is shown not only by stations, but by every individual unit, with one small exception, viz.: the first R.A. unit in Table V. The

TABLE VI.—RESULTS OF QUININE PROPHYLAXIS EXPERIMENT. INDIAN TROOPS—

ADMISSIONS FROM QUININE ROLL.

Station and Unit	Strength	1st Course		Interval		2nd Course		Next 6 weeks		TOTAL	
		Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total
PESHAWAR.											
Sikh Regt. ..	135	—	4	—	3	3	18	12	29	15	54
D.T.T. Coy. ..	148	2	8	2	3	4	10	29	34	37	55
Total Peshawar	283	2	12	2	6	7	28	41	63	52	109
Ratio per mille Peshawar		7·07		7·07		34·73		144·87		183·74	385·16
NOWSHERA.											
Distt. Signals	24	—	—	—	—	9	9	5	5	14	14
Mountain Bty.	109	3	5	4	4	11	16	34	41	52	66
Fd. Bty. R.A.	26	—	1	1	1	2	3	4	7	7	12
Fd. Bty. R.A.	38	1	4	—	1	5	6	4	16	10	27
Fd. Bty. R.A.	24	—	2	3	4	1	2	1	3	5	11
F.A.C. ..	32	—	—	1	1	—	1	5	10	6	12
Bombay Pioneers	222	4	9	15	19	41	45	63	69	123	142
Sikh Regt. ..	538	2	6	11	17	28	29	111	132	152	184
Dogra Regt...	350	4	4	10	10	57	64	102	115	173	193
Punjab Regt.	175	3	5	13	14	16	18	19	51	51	88
I.B.T. Coy. ..	198	11	17	11	13	69	74	44	57	135	161
D.T.T. Coy...	113	—	1	6	8	25	25	16	34	47	68
Total Nowshera	1,849	28	54	75	92	264	292	408	540	775	978
Ratio per mille Nowshera		15·14		40·56		142·78		220·66		419·14	528·93
SHAGAI. Landi Kotal from 30.10.29 Raj. Rifles ..	183	3	9	2	4	1	8	11	14	17	35
Ratio per mille		16·39		10·93		5·46		60·11		92·89	191·26
KOHAT DISTRICT. Thal/Hangu from 9.11.29 Punjab Regt.	92	1	2	1	2	—	2	3	6	5	12
Ratio per mille		10·87		10·87				32·61		54·35	130·43
Hangu up to 9.11.29 Jat Regt. ..	48	1	2	—	—	3	5	1	2	5	9
Ratio per mille		20·83				62·50		20·83		104·16	187·50
Grand Total— PESHAWAR AND KOHAT DISTRICTS	2,455	35	79	80	104	275	335	464	625	854	1,143
Ratio per mille		14·25	32·18	32·59	42·36	112·02	136·46	189·00	254·58	347·86	465·58
Equivalent annual ratio per mille		247·7	559·3	1189·4	1546·2	1946·9	2371·7	1642·5	2212·4	1350·7	1807·8

* N.B. – This is the sum of the estimated savings of each unit and does not agree with the

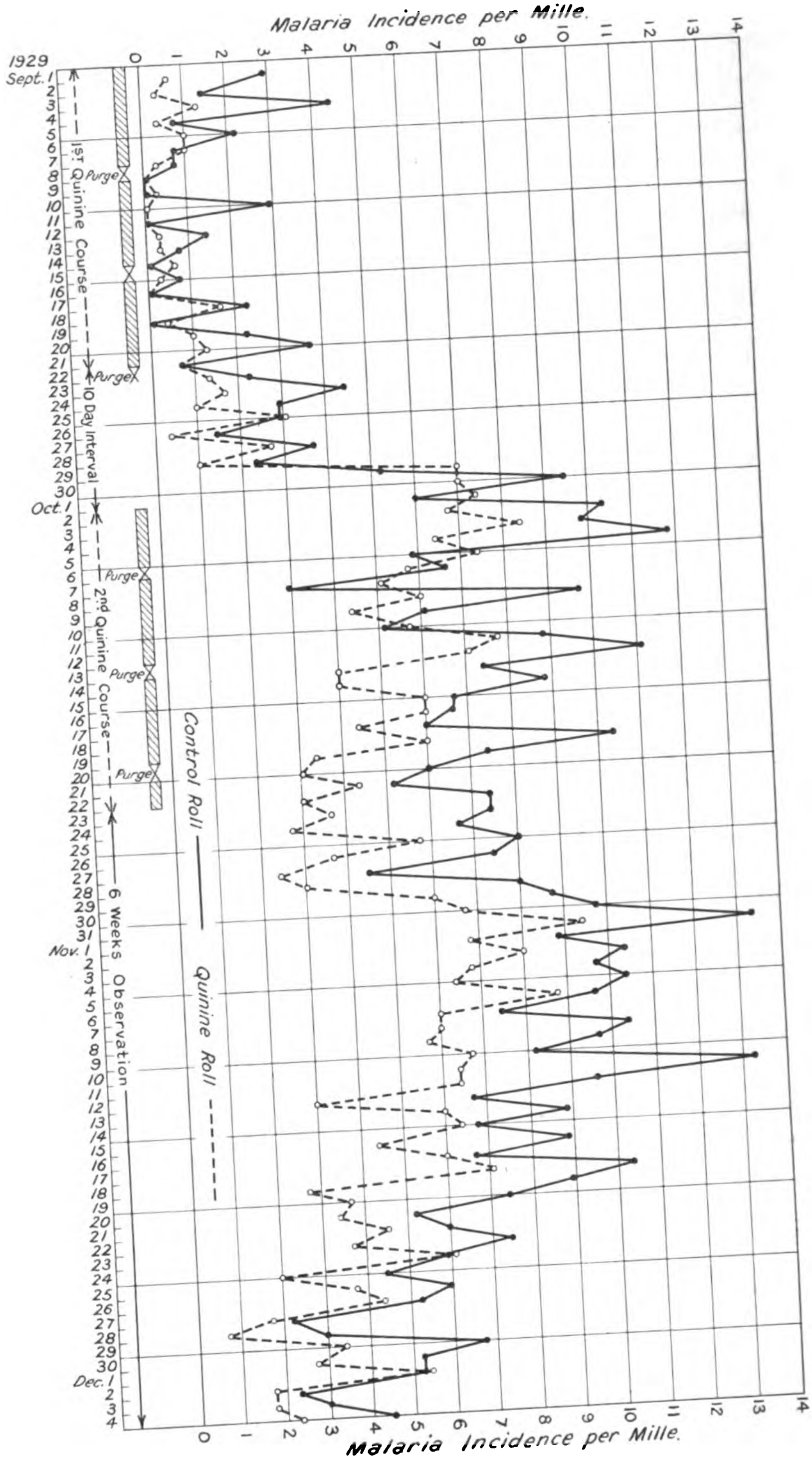
** Calculated on total incidence of all Indian units in Nowshera.

PESHAWAR AND KOHAT DISTRICTS. SEPTEMBER, OCTOBER, NOVEMBER, 1929.

Admissions from Control Roll.

Strength	1st Course		Interval		2nd Course		Next 6 weeks		Total		Estimated saving of Malaria admissions among quinine roll (Estimate based on rates prevailing among controls)	
	Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total	Mal.	Total	No.	Percentage
138	1	7	4	4	23	30	21	48	49	89	33	69 %
143	3	6	2	3	23	28	21	23	49	60	14	26 %
281	4	13	6	7	46	58	42	71	98	149	47	47 %
	14·23		21·35		163·70		149·47		348·75	530·25		
9	—	—	—	—	7	8	3	4	10	12	13	48 %
36	1	1	2	3	6	9	26	28	35	41	54	51 %
9	—	—	—	—	2	2	1	4	3	6	2	22 %
13	2	3	—	—	6	6	4	4	12	13	25	71 %
9	1	2	1	1	2	2	1	2	5	7	8	61 %
11	—	—	—	—	2	3	2	5	4	8	6	50 %
79	1	4	4	7	18	22	34	39	57	72	37	23 %
141	1	3	3	4	12	16	61	76	77	99	142	48 %
120	1	2	3	4	21	25	82	88	107	119	139	45 %
55	3	3	5	5	13	20	15	30	36	58	64	56 %
70	3	11	5	7	12	16	43	50	63	84	43	24 %
38	—	3	3	4	11	13	11	25	25	45	27	36 %
590	13	32	26	35	112	142	283	355	434	564	** (585	43 %)
	22·03		44·07		189·83		479·66		735·59	959·53		
93	4	19	—	3	—	7	33	36	37	65	46	63 %
	43·01						354·84		397·85	698·62		
92	2	3	4	4	5	9	1	4	12	20	7	58 %
	21·74		43·48		54·34		10·87		130·43	217·39		
49	6	6	—	2	3	3	1	1	10	12	5	50 %
	122·45				61·22		20·41		204·08	244·89		
1,105	29	73	36	51	166	219	360	467	591	810		
	26·24	66·06	32·58	46·51	150·23	198·19	325·79	422·63	534·84	733·03	665*	44 %
	456·1	1148·2	1189·1	1684·6	2611·0	3444·8	2831·2	3672·9	2076·7	2846·3		

estimated saving worked out on the total incidence of malaria for the whole area.


Malaria Incidence per Mille.
1929
Sept. 1
Oct. 1
Nov. 1
Dec. 1
1st Quinine Course
Purge
10 Day Interval
2nd Quinine Course
6 Weeks Observation
Control Roll
Quinine Roll
Malaria Incidence per Mille.

incidence in this unit in the six weeks period of observation was greater in the quinine group than in the controls, but this was due not so much to any undue sickness in the quinine group as to an unaccountable freedom from sickness in the control group. A comparison of the sick statistics in the second R.A. Battery and in other units should make this clear.

Effect of Prophylactic Quinine on Subsequent Treatment.

Officers were asked to note whether any difficulty occurred in demonstrating parasites in the blood of cases of malaria which had been receiving prophylactic quinine or whether any effect on treatment was observed. The general opinion was that parasites were quite as easily demonstrated in cases of malaria admitted from the quinine roll as in cases from the control, and that treatment was in no way affected nor the stay in hospital prolonged. These findings were in keeping with my own experience.

More precise work was done in Nowshera, and Colonel James [44] recording his experience the following year (1930) with Indian troops wrote: "Of fever cases which eventually proved to be malaria during the last eight weeks of prophylactic quinine only six out of a total of forty-six were missed at the first blood examination."

During the experiment of 1929 the average stay in hospital of British troops in Nowshera admitted for malaria was 5·90 days for quinine roll, and 5·08 for controls. The duration of fever after admission was also worked out in 100 consecutive cases. For quinine roll cases it was 3·1 days and for controls 3·4. The period after "admission" included any period of "detention" prior to actual admission.

One officer reported that many of his cases of malaria admitted from the quinine roll were afebrile. They complained of malaise, headache, loss of appetite, etc., and it was only when the blood-examination proved positive that a definite diagnosis could be made. These cases rapidly cleared up on quinine.

It would appear, therefore, that prophylactic quinine in no way prejudiced the diagnosis or treatment of intercurrent malaria.

Influence of Temperature.—The experience of the unit stationed at Shagai is of interest. There were 183 on the quinine roll and 93 controls.

Up to the date of departure for Landi Kotal (normal inter-Khyber reliefs) about 10 days after completion of the second quinine course, there had occurred 6 and 5 cases respectively among the quinine and control groups. The day following the arrival of the unit at Landi Kotal a sharp outbreak of malaria began, and the curious feature is that the control group were by far the heaviest sufferers, 32 cases occurring within the next $2\frac{1}{2}$ weeks, a ratio per mille of 344·1, against 10 for the same period in the quinine group, a ratio per mille of 54·6. The only explanation I can offer is the following: During the malaria season at Shagai a large proportion of the troops became infected, but the number of parasites present in the

blood was in most cases insufficient to cause an attack. The fatigue of the march (completed in one day) may have had some effect, but it is thought that the sudden change to the much lower temperature at the higher altitude of Landi Kotal lowered the body resistance and allowed the malaria parasites to get the upper hand. Most of the infections occurring in the quinine group were destroyed as a result of the course of quinine. The infections were not contracted at Landi Kotal for, apart from the fact that malaria cases began the day after arrival in Landi Kotal, units which had been continuously in the station during the malaria season had been practically free from malaria.

Effect of Quinine Prophylaxis on Troops previously free from Infection and on Troops who had been constantly exposed to Malaria.

A brigade of Artillery recently arrived from Jubbulpore consisted partly of seasoned troops, all of whom had spent one season and most many seasons in a malarious cantonment, and partly of a draft from home. The opportunity was taken to observe the results in each group.

The detailed results are given in Table VII. The malaria admissions (both drafts) for the quinine group represented a ratio per mille of 498 as against a similar ratio of 570 for the controls, a difference in favour of the quinine group of 72 per thousand. Corresponding figures for admissions for "allcauses" were 652 (quinine) and 710 (control), the quinine group benefiting to the extent of 58 per thousand.

In both the quinine and control groups a higher admission ratio is observed in the Jubbulpore draft. The difference is more marked in the controls, viz., 94 per thousand. In the quinine group the difference is 69 per thousand. Again in the Jubbulpore group the incidence in the quinine roll is 538 per mille and in the controls 608, a difference of 68 per thousand. Similar figures for the United Kingdom draft were 469 (quinine) and 512 (control), the difference being only 43 per thousand.

These results, though the extent of the experiment was small, appear to indicate that malaria was more prevalent among the "old stagers" presumably owing to relapses of old infections, and that the "old stagers" also benefited from the quinine to a somewhat greater extent than the new arrivals. This was in all likelihood due to the fact that the courses of quinine assisted in clearing up old standing infections.

Cost of Quinine Prophylaxis.

To work out the net cost of the whole experiment would involve a large amount of clerical labour. We may take, however, the Indian troops in Nowshera as an example (*vide* Table VI) :—

(*a*) 1,849 men were given 360 grains of quinine sulphate each (if they lasted the course).

The cost at Rs. 18/- per lb. was Rs. 1,710/-.

This is less than one rupee per man.

TABLE VII.—QUININE PROPHYLAXIS EXPERIMENT.

Summary of admissions for "Malaria" and for "All Causes" in drafts from U.K. and Jubbulpore to determine the relative effect of quinine prophylaxis on troops previously free from infection and troops who had been constantly exposed.

Unit	Quinine Group							Control Group						
	Jubbulpore Draft		U.K. Draft		Total			Jubbulpore Draft		U.K. Draft		Total		
	Strength	Malaria admissions	Strength	Malaria admissions	Strength	Malaria admissions	All Causes	Strength	Malaria admissions	Strength	Malaria admissions	Strength	Malaria admissions	All Causes
—/— Field Battery	45	25	48	27	93	52 (538 ‰)	69 (742 ‰)	17	15	23	9	40	24 (600 ‰)	25 (625 ‰)
— — — Field Battery ..	33	16	49	22	82	38 (464 ‰)	49 (598 ‰)	23	8	9	8	32	16 (500 ‰)	26 (813 ‰)
— • — Field Battery	26	15	46	18	72	33 (458 ‰)	43 (597 ‰)	26	17	9	4	35	21 (600 ‰)	25 (714 ‰)
Totals	104	56	143	67	247	123	161	66	40	41	21	107	61	76
Ratios per mille		538 ‰		469 ‰		498 ‰	652 ‰		606 ‰		512 ‰		570 ‰	710 ‰

NOTE I. As is to be expected, the Jubbulpore Draft, previously heavily infected, showed a higher incidence of malaria admissions than the draft from U.K.

II. Both drafts appeared to share, the Jubbulpore Draft to a somewhat greater extent, the benefits of quinine prophylaxis, though the beneficial effect in R.A. units appears to be much less marked than in Infantry units.

Several reasons may be advanced in explanation, e.g. (*a*) Ordinary barrack room discipline is generally not so good in R.A. units.

(*b*) Gunners are harder worked.

(*c*) Gunners during "stables" are exposed to bites by mosquitoes which harbour in the lines and fodder sheds.

reduction of the ferricyanide. The dextrose in the blood tubes will be increased in like amount, so that the difference between the sugar values of the blood tubes and the blanks remains unaffected by the slight deviation from N/200 of the ferricyanide solution.

Blood Tests.

0·4 cubic centimetre of blood was taken from a finger-prick, and was mixed with 20 cubic centimetres of freshly prepared 0·45 per cent zinc sulphate and 4 cubic centimetres of N/10 sodium hydrate solution (2). The tube was placed in boiling water for three minutes and the liquid was filtered while hot through a small plug of boiled cotton wool. The filtrate was crystal-clear. The filter was washed with 12 cubic centimetres of distilled water twice, and 8 cubic centimetres of the potassium ferricyanide reagent (3) were added and the whole was evenly divided in four test-tubes, so that each tube contained 0·1 cubic centimetre of blood and 2 cubic centimetres of potassium ferricyanide solution. The tubes were placed in a boiling water bath for fifteen minutes, cooled under the tap, and to each 3 cubic centimetres of the zinc sulphate-iodide solution (4) and 2 cubic centimetres of acetic acid (5) were added. Titration with the sodium thiosulphate solution was begun with the 1 cubic centimetre pipette and continued until the yellow colour had almost vanished, one drop of starch (7) was introduced on a glass rod and the titration continued with the 0·1, 0·05, and 0·01 cubic centimetre automatic pipettes until the last tint of blue had disappeared.

Tube 1 required 1·4 cubic centimetres of the thiosulphate solution which was equivalent to 1·41 cubic centimetres of N/200 sodium thiosulphate (factor 1·01).

Tube 2 needed 1·4 cubic centimetres of the thiosulphate solution equal to 1·41 N/200.

Tube 3 needed 1·4 cubic centimetres of the thiosulphate solution equal to 1·41 N/200.

Tube 4 needed 1·42 cubic centimetres of the thiosulphate solution equal to 1·43 N/200.

Therefore the mean quantity of N/200 thiosulphate was 1·415 cubic centimetres which is equivalent to 108 milligrammes of dextrose per 100 cubic centimetres. But from this must be deducted the mean sugar value of the blank controls, namely 24 milligrammes, leaving 84 milligrammes per 100 cubic centimetres as the dextrose titre of the blood.

Blank Control Tests.

Four blank control estimations were made in every respect similar to the blood tests, except that the four tubes contained no blood, with these results.

Tube 1 required 1·83 cubic centimetres of thiosulphate equal to 1·85 cubic centimetres of N/200.

Tube 2 required 1·84 cubic centimetres of thiosulphate equal to 1·86 cubic centimetres of N/200.

Tube 3 required 1·84 cubic centimetres of thiosulphate equal to 1·86 cubic centimetres of N/200.

Tube 4 required 1·84 cubic centimetres of thiosulphate equal to 1·86 cubic centimetres of N/200.

The mean quantity of N/200 sodium thiosulphate solution required for the blanks was therefore 1·86 cubic centimetres, which is equal to 24 milligrammes per 100 cubic centimetres when read from the Sugar Conversion Table.

These precautions are essential :—

(1) Cleanliness of test-tubes.

(2) Exact measurements of blood, potassium ferricyanide, potassium iodate, and sodium thiosulphate solutions.

(3) Standardization of the sodium thiosulphate solution before use.

(4) Absolute transparency and freedom from specks in the filtrate after coagulating the proteins.

It is advisable to take the mean of three or four blank experiments and to duplicate the blood tests.

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This does not take into consideration the fact that many men failed to complete the course. Actually 438 out of the total of 1,849 were admitted to hospital before the completion of the second quinine course, so the actual cost of the quinine was considerably less than the figure given.

(*b*) The estimated saving in malaria admissions was 585, calculated by units.

Take the average amount of quinine given to each case of malaria as thirty grains daily for three weeks. (Actually benign tertian cases got more, malignant tertian less.) Cost of quinine at Rs. 18/- per lb. was Rs. 948/-.

This is the cost of treatment with quinine alone, and when one considers the cost of other treatment (diaphoretics, soda salicylate, tonics, etc.) and the expenditure incidental to the stay in hospital, not to mention the loss to the unit in working days for training, etc., the contraction of a disease, so liable to relapse, a disease which plays no little part, direct or indirect, as a cause for invaliding, the cost of the preventive treatment seems amply justified.

In 1930, as already explained, there was no controlled experiment, superior authority having ruled that the case for quinine prophylaxis in the district had been proved beyond a shadow of doubt. All ranks were to receive quinine five days a week from the beginning of September to the middle of November and no controls were allowed.

The malaria curve commenced to rise earlier than usual. This was due to relapses of infections contracted during the severe epidemic of the previous autumn. In July and August the incidence was unduly high, an example of the "flowering time" of malaria parasites recently described by Martini [45], but in September, soon after the commencement of prophylactic quinine, the outbreak suddenly died out, and, in the months when the disease is usually at its height, the sick rate was extremely low. How far the quinine was responsible for this eminently satisfactory state of affairs it is impossible in the absence of controls to state with any degree of assurance. The malaria curve, so far as Nowshera is concerned, is illustrated in an article in the *Indian Medical Gazette* by Lieutenant-Colonel J. F. James [46].

If quinine has played no part in the welcome freedom from malaria during September and October, 1930, the phenomenon is capable of explanation according to the Quantum Theory of Gill [47] in that immunity from malaria has become extremely high as a result of the severe epidemic of 1929. It may here be observed that a similar freedom from malaria occurred in 1931, so there was still no loss of equilibrium between the quantum of immunity and the quantum of infection. Quinine prophylaxis was commenced, but was soon discontinued.

A questionnaire was sent out to thirteen hospitals.

The opinions expressed may be summarized as follows :—

(*a*) Commanding and other officers consider quinine prophylaxis, as practised in Peshawar District, effective in reducing materially sickness due

to malaria. Commanding officers in particular have been so enthusiastic that there has been difficulty in past years in securing a body of men to act as control. The O.C., naturally enough, wants the whole unit to benefit and does not altogether appreciate the scientific reason for the control.

Officers of the medical services, many completely sceptical at first, became thoroughly convinced as to the efficacy of this form of preventive treatment.

(*b*) Apart from the taste of quinine, which is generally disliked, the process was popular with the men on the whole, and particularly so with many Indian units. Many Indian other ranks brought their children for quinine. There appeared to be a general feeling of confidence in the beneficial effects to be derived from the course.

(*c*) The only suggestion made was that the full dose of ten grains should be assured by using a measure slightly larger than one ounce or by making up the mixture somewhat stronger, say twelve grains to the ounce.

(*d*) In the epidemic year 1929 the percentage of fever cases to total admissions was in most cases extremely high.

(*e*) It will be noted also that in the epidemic year 1929 the incidence of malignant tertian malaria was relatively very high.

(*f*) There was no evidence of quinine-fast parasites.

(*g*) With two exceptions, both very small hospitals, all agreed that quinine prophylaxis did not render more difficult the detection of malaria parasites in the blood stream.

(*h*) There was no evidence of "suppression" of malaria.

Quinine Prophylaxis worth while?

Judging from the results obtained in the experiments during the four years to 1929, I think it must be admitted that quinine prophylaxis as practised in Peshawar and Kohat Districts did actually effect a considerable reduction in the hospital admission ratio. It is fully appreciated that the accuracy of the term "prophylaxis" as applied to the method adopted is open to argument. Perhaps "massed treatment of potentially infected troops" would be a more accurate, though somewhat cumbersome, description. The choice of terms, however, is of little moment.

In addition to the reduction in malaria directly due to quinine prophylaxis, it appears to me that a further reduction may result indirectly. Fewer individuals becoming infected, there are fewer carriers to infect anopheline mosquitoes, a smaller proportion of which become infective. Thus the risk of being bitten by an infected mosquito and so contracting malaria is diminished.

It is not contended that quinine prophylaxis is the best method of reducing sickness due to malaria. There are many drawbacks to its use which may seriously interfere with its effectiveness. Quinine has an unpleasant taste, its administration must be very carefully supervised to

ensure that the dose is actually taken and that it is absorbed. Also the expenditure entailed is of necessity a recurring one.

It is not suggested that quinine prophylaxis should take the place of other anti-malaria measures of which probably screening holds out the greatest promise, though up till recently in the districts concerned anti-mosquito measures (mostly anti-larval measures) have been chiefly relied upon, with very indifferent results. The large initial cost of screening is a very serious obstacle, however, and this method is seldom practicable under service conditions, and more especially with the type of campaign common on the Frontier. In such circumstances even the mosquito net has to be discarded, and the only defensive weapon remaining is quinine.

All the disadvantages of a prolonged course of quinine, including the cost, which is rather less than eight annas a man for a three weeks' course, must be weighed carefully to determine whether the benefits likely to accrue outbalance the disadvantages. In Table IV, p. 336, I have included a column which shows the estimated saving, year by year, of malaria admissions as a result of the quinine administered. This is, of course, a hypothetical figure which is obtained by assuming that the rate among the controls would have prevailed generally if no quinine had been given. This rate is applied to the quinine roll, and from the resulting figure is subtracted the total which actually occurred. This gives the "estimated saving" which affords a fair idea of the effect of the quinine prophylaxis. From the results for 1926 and 1929 the trouble and expense involved seem amply justified. In 1926 the administration of quinine to 210 men for three weeks at a cost of approximately Rs. 100 was a very small price to pay for a saving of forty-seven cases of malaria. In 1929, the estimated saving during the malaria season among British troops was seventy-three cases. Against this saving must be debited the labour and energy expended in issuing quinine to 473 men for two periods of three weeks each, the organization necessary and the collection of statistics. The cost of quinine was about Rs. 400. Surely this is not excessive! One must remember also that the organization required and the statistical and other work involved in an "experiment" of this nature are very much greater than would ordinarily be the case. This fact was duly appreciated in 1930 when there was no experiment, and although quinine was given over a much longer period than in any previous year. Again, among Indian troops in 1929, for a sum of about Rs. 2,000, an estimated saving of 459 cases of malaria was effected. An even better return is shown if the figures for Nowshera alone are considered.

The expense may be thought high; but one has to consider the large sums of money being spent on anti-mosquito measures (exclusive of screening), as much as Rs. 10,000 per annum in one cantonment alone, without any apparent reduction in the incidence of malaria.

The results cited above for 1926 and 1929 in my opinion justify the expense and work involved. In these years malaria was in epidemic form and mainly malignant tertian in type.

The position as regards the rest of the experiment is different, however. With the exception of the case of British troops in 1927 when quinine was given in September and October for three weeks each month to 194 men at a cost of not far short of Rs. 200, the estimated saving being thirty cases of malaria; most people will conclude that the saving effected was not worth while, e.g., a possible saving of six malaria cases was effected in Indian troops in 1928 at a cost of about Rs. 2,000 in quinine, not to mention the trouble and worry involved in distributing quinine to 1,142 men of several units for two periods of three weeks each. The same can be said of the results for British troops in 1928 and for Indian troops in 1927 and for the Chitral Relief Column in 1928, though in these instances, and particularly the British troops in 1928, the case is not so marked.

My contention, therefore, is that while the value of quinine prophylaxis in reducing sickness due to malaria in British and Indian troops in Peshawar and Kohat Districts in epidemic years has been proved, one cannot make out a good case in support of its practicability in non-epidemic years, particularly among Indian troops.

As a result of the experience gained during the years 1926-1930, I would confidently recommend the issue to all troops in malarious stations in Peshawar and Kohat Districts, during epidemic years, of prophylactic quinine, ten grains daily in solution, five times a week from mid-September to mid-November.

Epidemic malaria can now be forecasted [48] with assurance, though it should be borne in mind that the conditions in different parts of India vary enormously. In 1929 the admission ratio for malaria for the whole of India was the best for any year except 1928 since the Great War [49], yet the North-West Frontier Province had by far its worst epidemic on record.

Though eminently satisfactory results have been obtained, I am convinced that these can be greatly improved upon. The dose may require modification to suit local conditions, intensity of infection, etc. A more suitable preparation may be substituted, e.g., the experience gained during the Chitral Reliefs demonstrated that tablets could be given satisfactorily. If the disadvantages inherent in tablets could be successfully overcome, the increased popularity resulting from their use might outweigh the increased cost. During a campaign tablets may be the only feasible method of administration.

There are other possible avenues for improvement. My own small experience of plasmoquine in treatment, and the recorded results of Williams [50], Deeks [51], Barker and Kemp [52], Whitmore, Ronnefeldt [53] and others, suggest a wide scope in the field of prophylaxis for this and similar drugs which attack the parasite in its sexual phase. Recently, James, Nichol and Shute [54] have carried out an experiment in which ten volunteers were given plasmoquine for seven days. On the second day they were bitten by mosquitoes heavily infected with the sporozoites

of benign tertian malaria. Not one became infected.[1] Four control cases, one of whom was given quinine for eight days, developed malaria within fourteen days.

It must not be forgotten, however, that plasmoquine sometimes produces alarming symptoms. But, if this disability can be overcome, a combination of quinine and plasmoquine may prove the ideal compound for both prophylaxis and treatment.

V.—Summary and Conclusions.

(1) Quinine prophylaxis, as put to the test in Peshawar and Kohat Districts in the years 1926 to 1929, effected a considerable reduction in the sickness due directly and indirectly to malaria. This was a true reduction which was reflected in a fall in the ratio of admissions for "all causes."

(2) There was evidence that a reduction in sickness due to causes other than malaria followed the use of quinine in Indian troops.

(3) Quinine prophylaxis appeared to be somewhat more effective in troops previously exposed to infection than in troops not so exposed, due no doubt to its curative effect in some cases which, without the course, would have relapsed.

(4) No ill-effects attributable to quinine prophylaxis were noted, and ability for work or games was not affected.

(5) Treatment of cases of malaria, the severity of the attack, or the duration of stay in hospital were not prejudicially affected to any material extent by previous quinine prophylaxis, and in one hospital many cases admitted from the quinine roll were noted for their mildness.

(6) The recognition of malaria parasites in cases of malaria was not rendered more difficult by the fact that such cases had been taking prophylactic quinine.

(7) There was no evidence that quinine prophylaxis suppresses malaria nor that suppressed malaria shows itself after the cessation of quinine

(8) There was no evidence of the production of quinine-fast parasites.

(9) The "interval" (ten days' rest period between courses) was not only unnecessary, but actually detrimental.

(10) Cold as a factor in lighting up latent cases of malaria was demonstrated. The same incident revealed the power of "quinine prophylaxis" in destroying this latent malaria before it could give evidence of its presence.

(11) The cost of quinine prophylaxis is considerable, viz., about eight annas per man for a three weeks' course. There is a great deal of work involved in the process, and constant supervision is necessary. It should be remembered also that these extra duties are thrust on hospital staffs depleted by the necessary calls for leave, exhausted after the strain of

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[1] These cases developed fever several months later.

the hot weather, and working at full pressure with other anti-malaria duties as well as with the ordinary medical routine. Bearing these facts in mind the meagre beneficial results obtained during non-epidemic years can hardly justify the cost. In epidemic years, however, the outlay in money and energy has been amply repaid by the satisfactory outcome of the experiment described. I consider, therefore, that malaria forecasts should be carefully studied in malarious districts of the North-West Frontier Province and that quinine prophylaxis should be given in years forecasted as epidemic. The method recommended is a ten-grain dose five times a week from mid-September to mid-November, with a weekly aperient.

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THE MODERN DIAGNOSIS AND TREATMENT OF SYPHILIS.

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(*Continued from p.* 349.)

TERTIARY STAGE.

Gummata in any part of the body may resemble non-specific tumours of many kinds. It is far too large a subject to enter into here. There may be many distinguishing accessory signs and there is always the blood test. Suffice it to say that the typical gumma is very chronic, constantly breaking down, painless and non-infective.

An interesting condition in this stage is chancre redux or chancriform gumma on the site of the original sore, firm, hard, painless. Spironemes are never found, and the blood test is always positive. It is nearly always confused with a primary sore and the unfortunate patient always thinks himself in for another attack. This is another illustration of the mimicry of syphilis.

Congenital Syphilis.

This is precisely the same disease as acquired syphilis, but one does not of course see the primary stage. If the mother is infected early in her pregnancy the child is born with tertiary signs, if late with secondary.

As regards the differential diagnosis—the rashes are dealt with on the same lines as acquired syphilis and the tertiary signs are usually quite obvious and unmistakable.

Preliminary or Clinical Diagnosis.

We will now suppose that our patient presents himself for examination. The first essential is a good light. The patient stands facing the window, he removes his clothes down to the ankles and at first glance we can decide whether or not he has a rash.

The penis is then examined. The patient is instructed to retract the foreskin and in most cases a sore will be found on the glans or in the coronal sulcus. A note is made of the type and appearance of the sore. Next the inguinal glands are palpated, note being made of their type, shotty or otherwise. Then the remaining glands are dealt with, the epitrochlear, the axillary, the cervical, the submaxillary and the submental.

The next step is to examine the mouth. A tongue depressor is used and the fauces are examined, probably ulceration may be noted, then the palate, the inflammation being limited to the soft palate. Then the patient is told

to put out his tongue and the dorsum is noted, then to turn it to the right and then the left whilst the sides are examined, finally he is told to touch the roof of his mouth with the tip of the tongue and the under surface is observed. Next the tongue depressor is carried round the inner sides of the cheeks and the buccal mucous membrane and the teeth and gums are noted. All this is very important and it should always be done in a routine manner as the mouth is one of the commonest places for secondary syphilis to show itself.

The patient then turns round and a note is made as to the presence or absence of a rash on the back. Next he is told to stoop down and separate the folds of the buttocks with his fingers and the presence or otherwise of condylomata is noted.

Finally the central nervous system is examined, note being specially made of Argyll Robertson pupils, Rombergism, and loss or inequality of knee-jerks.

After this complete examination certain definite deductions may be made. We may have definitely decided that the man has syphilis or we may be in doubt. We then proceed to the actual diagnosis, which is, of course, bacteriological.

The Actual Diagnosis.

We have now to try and find the organism. The microscope used has a dark-ground condenser, which differs from the ordinary condenser in having a central stop. Light does not therefore pass directly through it from the reflector but comes up the sides and when it reaches the surface it is bent inwards directly across the specimen on the slide. The rays are almost horizontal and resemble the beam of dust seen in a room on a summer's day. Any particle in their path is intensely illuminated. Organisms therefore show up very clearly, and as they are living bodies and motile, definite movements can be observed. It was not until the elaboration of this kind of microscope that the *Spironema pallidum* was discovered by Schaudinn and Hoffman.

The source of illumination is a powerful electric light, or in India, where there may be no installation, the direct sun.

The specimen is taken in this way. The sore is thoroughly cleaned up with saline and then rubbed firmly with more saline; after a few minutes the sore is squeezed between gloved fingers and serum allowed to flow; this is placed on a fine cover slip which in turn is placed on a fine slide and ringed round with vaseline in the usual way.

The specimen is placed under the microscope and there appears at once a striking picture resembling twinkling stars against a dark background. These twinkling objects indicate that the serum is alive and that it is worth going on with our examination. The spironeme may be found at once; it may require much careful and patient searching. Suppose we have found one? What does it look like? It is a very fine, spiral-shaped body, like a delicate corkscrew, of dead-white appearance. It moves only

very slowly across the field, perhaps only a gentle to and fro movement may be observed. It has about 12 to 14 or more spirals and of these about 10 equal the diameter of a red blood-cell. With further observation a bending movement is seen, usually from the middle so that the head may touch the tail. This is the final clinching sign for which we have been looking. No other spironeme possesses this characteristic. Other spironemes, of which there are many different kinds, have of course to be excluded. All these are coarser with more open spirals; they move rapidly across the field, are not dead white and do not bend. Another movement which I have recently observed in this country and never abroad, is that in which a small loop forms in the middle and travels to one or other end, much in the same way as a loop may be sent along a cowboy's lassoo rope.

This completes our diagnosis and we can proceed at once to the treatment of the case. But suppose we cannot find any spironemes? A further attempt is made the next day, the sore in the meanwhile being treated with saline. Four separate examinations are made on four separate days on the off chance of getting an early diagnosis. If the examination is still negative we shall have to rely on the blood test, which is done, of course, in any case.

THE BLOOD TEST FOR SYPHILIS.

The Wassermann test is a specific test for syphilis and save for yaws and malaria, during the pyrexial period, no other disease will show, with the modern technique, a positive reaction.

The Kahn test, more recently discovered, is a less complicated one and may ultimately supplant the Wassermann test. The results are very similar; it is perhaps more sensitive, particularly after a course of treatment, and it has already been accepted as a standard test in certain countries. So far, it has not been officially recognized in this country, and (both tests are therefore carried out in Army laboratories at the present time.)

The blood is taken from a vein in the arm, allowed to stand for twenty-four hours and the serum pipetted off into a Wright's capsule and sent by post to the laboratory at the Royal Herbert Hospital, Woolwich. Here the test is carried out and we await the result.

We now come up against several snags and much popular ignorance. If the blood is positive all well and good. We can either make or confirm one diagnosis. Suppose it is negative. It must, of course be repeated. The chief reason is that in the early stages the blood is not usually positive, in fact in the majority of cases it is negative for the first eighteen days and this is called the pre-Wassermann stage. This is very little understood and mistakes are frequent. Well, we take the blood again and find it still negative. How long are we to go on taking it? To exclude syphilis we must continue for three months. In the Army it is taken weekly for the first four weeks, again at the end of the second month and finally at the end of the third. If it is still negative we can dismiss any question of syphilis from our minds with absolute confidence. Suppose this is so with our

present case of sore, we can now diagnose soft chancre. On admission the patient will have had a note made in his documents of N.Y.D. (V.S.). This has been made in pencil. We can now make in ink our permanent entry of soft chancre on his documents.

It will thus be seen that we are not allowed to diagnose this condition under three months, a point not always realized by clerks in the office who are getting anxious about their returns.

To return to our syphilis case; he has now been diagnosed by either the dark-ground or the Wassermann test. Treatment must be started at once.

Before leaving this subject I should like to point out one further snag in regard to the Wassermann test, and it is this: the greatest care should be taken in interpreting a report on a pregnant woman. False results are quite possible, i.e., a negative report may be given on a woman who is suffering from syphilis. The actual cause is not understood, but it is thought that the liquor amnii may have something to do with it. A case was seen abroad in a woman who was infected by her syphilitic child, who in turn had contracted it from a native servant. The mother's condition was not diagnosed till a full secondary rash had developed. The reason for her negative Wassermann was a pregnancy, terminating at three months, which had not been disclosed. I am quite sure that she owed her very late diagnosis solely to the fact that pregnancy invalidated the Wassermann test.

The Treatment of Syphilis.

Before discussing the modern treatment of this disease it might perhaps be of some interest to cast our minds back to an earlier time and reflect on the great changes which have taken place in our knowledge of the disease.

Our earliest records are perhaps somewhat vague and unreliable, but it is now generally accepted as correct that syphilis was first described in the concluding years of the fifteenth century. It certainly spread through Europe in the years following the return of Columbus and his sailors from America. It may have existed before, but there were many astute observers living at that time, who would undoubtedly have recorded its signs and symptoms, had it existed, and so we are rather forced to the conclusion that Columbus's sailors did in fact bring it back with them to the Old World [2]. So the organisms of syphilis were probably amongst the first of the American commodities dumped on a complacent Europe, and in the four or five succeeding centuries she has strived to cope with the legacy of trouble which they brought.

It appeared on the Mediterranean seaboard in 1493. It was carried to India by Vasco da Gama and it spread to the British Isles in 1497, where it was first recorded in Scotland. The first place in Scotland where it is known to have occurred was Aberdeen. In justice to this much abused city it would perhaps be more accurate to say that this was the first place

where any public health measures were known to be adopted. In 1497 the Aberdeen Town Council ordered that "For protection from the disease which has come out of France and strange parts, all light women desist from their vice and sin of venery and work for their support, on pain else of being branded with a hot iron on their cheek and banished from the town" [3].

In England it was called the French disease, in France they called it the Italian, in Italy the French; the Russians blamed the Polish, and the Indians blamed the Portuguese. It was not for many years that international asperities were mollified and the name "Syphilis" came into being. It was actually named in the year 1530 by Frascatoro, a poet and physician, who wrote a poem called "Syphilis or the French Disease." In this poem a swine herd called "Syphilos" was the legendary hero and he was supposed to be the first sufferer.

In our own country many famous people contracted it, many doctors tried to treat it. Its actual mode of conveyance was not known in England in those early days, whatever may have been known in Scotland. It is generally understood that Henry VIII had the disease. In fact it is recorded that he knew he had it, for he accused Cardinal Wolsey of giving it to him, by whispering in his ear. He certainly had a chronic ulcer of the leg, which lasted for many years, and his wives and mistresses were equally prolific in their abortions.

Our first actual record of the treatment of the disease is towards the end of the fifteenth century when after Paracelsus had introduced his metallic theory of the treatment of all disease, Jean di Vigo in the year 1497 commenced with mercury. This drug was really quite an effort for those early days, for it held the field till our own time and only went out of general use in the last few years.

Late in the seventeenth century nitric acid and opium were used. That opium also was administered is not surprising. Then in the early part of the nineteenth century came the next important discovery, viz., iodine, which, with mercury, was the standard treatment till recent times. Mercury and potassium iodide! Our minds go back to our student days with clinical pictures of gummata, aneurysms, cerebral abscesses, and all the other horrors of the out-patient department, and they were all doped with mercury and iodides, and week by week we saw the same old cases with practically the same old signs.

Then in the early years of the present century came the great trio of German discoveries. 1905 saw the discovery of the *Spironema pallidum* by Schaudin and Hoffman, 1906 the Wassermann Test, and 1910 Ehrlich's salvarsan or "606." Still later came the "neo" group, neosalvarsan, etc., and still later in 1923 bismuth.

Now, let us review the situation of salvarsan at the outbreak of the War. In the few short years prior to the commencement of hostilities it had been used in many countries and our own Corps were pioneers in its em-

ployment. Its results were dramatic. Lesions which had resisted mercury and potassium iodide cleared as if by magic and the great cure had at last been discovered. In military hospitals over 80 per cent of syphilis cases had to return to hospital within the first year of their discharge and they were there for very long periods. The clinical relapses nowadays are nil.

Unfortunately the Wassermann test, so recently discovered, showed that the blood was not always brought to a negative reaction and several injections had to be given and still more as time went on. This was the state of affairs in 1914. Then came the War and all supplies of salvarsan, whose sole source was Germany, were cut off. The method of manufacture was not, however, secret. The Government appointed a Commission to investigate and Messrs. Burroughs and Wellcome were authorized to make an English equivalent which they called Kharsivan.

Table III gives a summary of the modern drugs used in the treatment of syphilis and their country of origin.

TABLE III.

Germany		*France*	*England*
"606"	Salvarsan	Arsenobillon	Kharsivan
....	....		
"914"	Neosalvarsan	Novarsenobillon (N.A.B.)	Neokharsivan
		Sulfarsenol	Sulphostab

Notes on Table III.

The dotted line represents the commencement of the War. The French novarsenobillon was used for some years, then neokharsivan for a time, more lately sulfarsenol, and at the present time the British drug sulphostab is in general use. All these are excellent drugs.

Now to return to mercury and potassium iodide. It was gradually found that the arsenic of the "606" group was not sufficient in itself and accessory treatment had to be carried out and so these two drugs were again taken into use. Mercury held the field till the introduction of bismuth. Nowadays mercury has quite gone out of use in the Army except in very isolated cases and bismuth is our main accessory drug.

The reason is not far to see. Picture the cases long treated by mercury; the debilitated condition, the frequent and distressing diarrhœa, the loss of weight, the ulceration of the mouth, the stomatitis, the loosening of the teeth, the foul breath, the intense salivation and the feeling of sheer misery which many of these patients developed. The physicians were satisfied for their cases were said to be mercurialized. The patients were not, for they preferred the disease which was painless to the treatment which was painful. The wealthy in their hundreds moved to Aix la Chapelle and consumed gallons of sulphur waters, the poor in their thousands remained at home and endured the misery of their condition with such philosophy as they could command.

In the Army I had over a hundred cases of stomatitis under treatment at the same time. This was in Cologne and the year 1923 ; but it was very nearly the end of the chapter for in the following year bismuth was taken into general use. At Colchester in the last year of mercury the average loss of weight after a course of injections was 7½ pounds. In the first year with bismuth this loss was converted into a net gain of half a pound. Here in Aldershot our average was a gain of 1·28 pounds for last year. That is a tremendous advance. The general appearance of these cases improved out of all recognition ; they are now definitely fitter and healthier and there is no more stomatitis, the bugbear of the syphilologist and the dentist alike. The recently qualified dental officer of the present day has little conception of the enormous amount of work he is saved by the substitution of bismuth for mercury and the complete disappearance of stomatitis.

THE GENERAL SCHEME OF TREATMENT.

The drugs at present in use in the Army are sulphostab, bismostab and potassium iodide. Sulphostab is given deep subcutaneously and bismostab intramuscularly.

The total amount of treatment depends on the stage of the disease at which it starts : if the condition is diagnosed early less treatment is required than if it started late. The modern tendency is for more and more treatment to be given and in the last twelve years I have seen the amount quadrupled.

Table IV shows the details of a unit course of standard treatment.

TABLE IV.—A UNIT COURSE OF TREATMENT.

Number of injections	Day	Sulphostab	Bismostab
(1)	1	0·45 gramme	0·2 gramme
(2)	8	0·45 ,,	0·2 ,,
(3)	15	0·45 ,,	0·2 ,,
(4)	29	0·6 ,,	0·2 ,,
(5)	36	0·6 ,,	0·2 ,,
(6)	50	0·6 ,,	0·2 ,,
(7)	57	0·6 ,,	0·2 ,,
(8)	71	0·6 ,,	0·2 ,,
(9)	78	0·6 ,,	0·2 ,,
(10)	85	0·6 ,,	0·2 ,,

Six weeks' rest, during which the Wassermann test is carried out and potassium iodide 20 grains t.d.s. is given, by the mouth, for fourteen days. (0·6 of sulphostab is usually commenced at the second injection for men of big build like guardsmen).

Cases are classified as shown in Table V.

TABLE V.

Early primary, i.e., positive D.G., negative W.T.	30/30
Late primary, i.e., diagnosed on a positive W.T.	40/40
Medium primary, i.e., positive W.T. after provocative injection ..	35/35
Secondary and later	40/40

It is thus seen that the early primary case receives three unit courses of ten injections each of sulphostab and bismostab.

Explanation of " medium primary " : after a preliminary injection of an arsenobenzol drug it is found that the blood is more sensitive to the Wassermann test. This phenomenon is called the Jarisch-Herxheimer reaction; its full effect occurs after ten days and advantage is taken of this to establish a comparatively early diagnosis. If the test is positive the injection counts as the first in the course and if it is negative no harm has been done.

Complications of Treatment.

(1) Immediate reaction or within twenty-four hours.

(2) Jaundice.

(3) Exfoliative dermatitis.

(4) Acute yellow atrophy.

(1) Under the old " 606 " treatment reactions were frequent and severe. Although a very useful and potent drug the original salvarsan often produced such severe reactions that the venereal clinic frequently resembled a first-aid post. With the introduction of the " 914 " group these severe reactions ceased and it is very rare nowadays to see anything more than a transitory discomfort.

(2), (3) and (4) are apt to occur late in the course of treatment and jaundice most frequently comes on about the commencement of the third course. Exfoliative dermatitis, a very fatal complication, usually occurs in cases of xerodermia and ichthyosis and such cases should always be treated with extreme caution. All these complications are fortunately very rare under the present conditions of treatment.

Precautions.

In spite of the rarity of these complications it is, however, advisable for certain precautions to be taken :—

(1) Careful notes are recorded weekly of present condition, and any reactions [4].

(2) Weight is recorded weekly.

(3) Urine is tested for albumin before each injection.

(4) A solution of sugar is given beforehand by the mouth. This is converted into glycogen in the liver and buffers out the circulating arsenic and so prevents damage to the liver-cells, jaundice and acute yellow atrophy.

(5) The water used for dissolving the arsenic is always used absolutely fresh. This is one of the most important items in modern arsenical therapy. Storage of water causes subtle changes to take place and there is a great difference between fresh distilled water and that which has been stored for twenty-four hours. At the Connaught Hospital it is distilled in an earthenware still the night before, redistilled the morning of use and given quite cold.

In the early post-War years in Salonica we gave large numbers of intravenous quinine injections for malignant malaria. The reactions were very severe and I am quite sure now that much of this was due to our ignorance regarding distilled water. The water we used had often been stored for six months in a rubber-capped bottle in the operating theatre. I think with our present knowledge we should not see such frequent and severe reactions.

(6) Adrenalin is kept on the table ready to cope with any emergencies. Dose: one cubic centimetre of 1 in 1,000 hypodermically. It can also be given prophylactically a quarter of an hour beforehand to cases which tend to develop urticaria soon after injection. Sodium thiosulphate is also of value for arsenical reactions. These drugs are given plus all the usual remedies for shock.

SYPHILIS SURVEILLANCE.

Surveillance is carried out for two years after cessation of treatment [5]. Cases attend quarterly for blood tests during the first year and half yearly during the second. If they are then negative they are struck off observation and the appropriate entry is made in the medical history sheet.

If a man leaves the Army during treatment or surveillance he is furnished with a card (V. 15A) containing full particulars of his treatment, and he takes this to the nearest civil venereal clinic, a complete list of which is maintained in the Dermatological Centre.

RESULTS OF TREATMENT.

With treatment commencing in the early primary stage the results are excellent, and provided the case has sufficient treatment no anxiety need be felt for the future welfare of our patient. With treatment starting in the late primary stage the results are probably quite good but we can be less sure. Still later, and even after prolonged treatment we can only say that we hope for the best.

In the Army we can definitely say that there is nowadays very little secondary, hardly any tertiary syphilis, and clinical relapses are practically unknown. The average stay in hospital is about twelve to fourteen days.

Anticipating the possibility of a question on the present-day incidence of tabes and G.P.I. in relation to all this treatment which I have indicated, I wrote to Colonel Harrison, one of our retired officers, who, in addition to being our leading authority on the subject, is Medical Adviser to the Ministry of Health on all venereal problems, and he informed me that whilst many different factors may affect the situation, three definite facts materialized in comparing the present position with that of twenty years ago. These facts are: (1) The mortality of tabes is the same; (2) that of G.P.I. is about half; (3) a rise in the incidence of these diseases which might have been expected from the great increase in new infections during the War period is not yet apparent.

Marriage and Syphilis.

A doctor is often asked by his patient how long he should wait before marriage. The only safe reply is that provided all the tests are negative, he should wait at least two years after finishing his surveillance, i.e., four years after cessation of treatment. Another point is that a woman who has once had syphilis should always, whatever the state of her blood, receive a further course of treatment during each pregnancy.

Wassermann-fast Cases.

It sometimes happens that in spite of all this treatment a case may not give a negative blood test. What are we to do? Frankly we are rather up against it. The general principle should, however, be laid down that as long as the blood test is positive he should continue with treatment.

A positive test means living spironemes somewhere in the body. These may be dormant and cause no immediate harm but they may light up under favourable conditions and cause further manifestations of the disease. It is like the sword of Damocles hanging over a man's head, and such a case must be prepared to go on with treatment.

We may give another course and again take the blood. I have known a case become negative after being positive for eighteen years. Or we may change the arsenical drug for some other arsenical preparation. If this does not prove effective we may try administering small doses of thyroid extract for the first few weeks of the next course. It is thought that this activates the drug or makes the tissues more receptive and cases do undoubtedly tend to become negative in this way.

Recently our attention has been directed towards protein shock, and whole blood injections of ten cubic centimetres have been recommended. I have tried several cases, but it is too early to express any opinion on the subject.

Wassermann-fast cases occur frequently in the Indian Army and it is a well-recognized phenomenon that natives of the East tend to react somewhat differently from Europeans. These patients often require prolonged treatment and careful and continued observation.

In conclusion, I should like to pay a word of tribute to the Venereal Centre at the Royal Herbert Hospital, Woolwich, where our Special Treatment Orderlies are trained. The work which is done for the Corps at that Centre and the excellence of the orderlies they send us are perhaps not sufficiently realized. Many of these orderlies possess a technical knowledge of their subject far surpassing that of the average general practitioner and the help they give to us in our day-to-day work is of the greatest value.

In India, too, we owe a debt of gratitude to the specially trained Assistant Surgeon, who in a highly efficient manner plays also his part in the conquest of this disease.

Thanks are due to Major-General J. A. Hartigan, C.B., C.M.G., D.S.O., K.H.P., D.D.M.S., Aldershot Command and to Lieutenant-Colonel E. M. O'Neill, D.S.O., R.A.M.C., Officer Commanding the Connaught Hospital, Aldershot, for kind permission to submit this lecture for publication.

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[1] "The Diagnosis and Treatment of Venereal Diseases in General Practice," Fourth Edition, by Colonel L. W. Harrison.

[2] "Devils, Drugs and Doctors," by Howard W. Haggard.

[3] *Idem.*

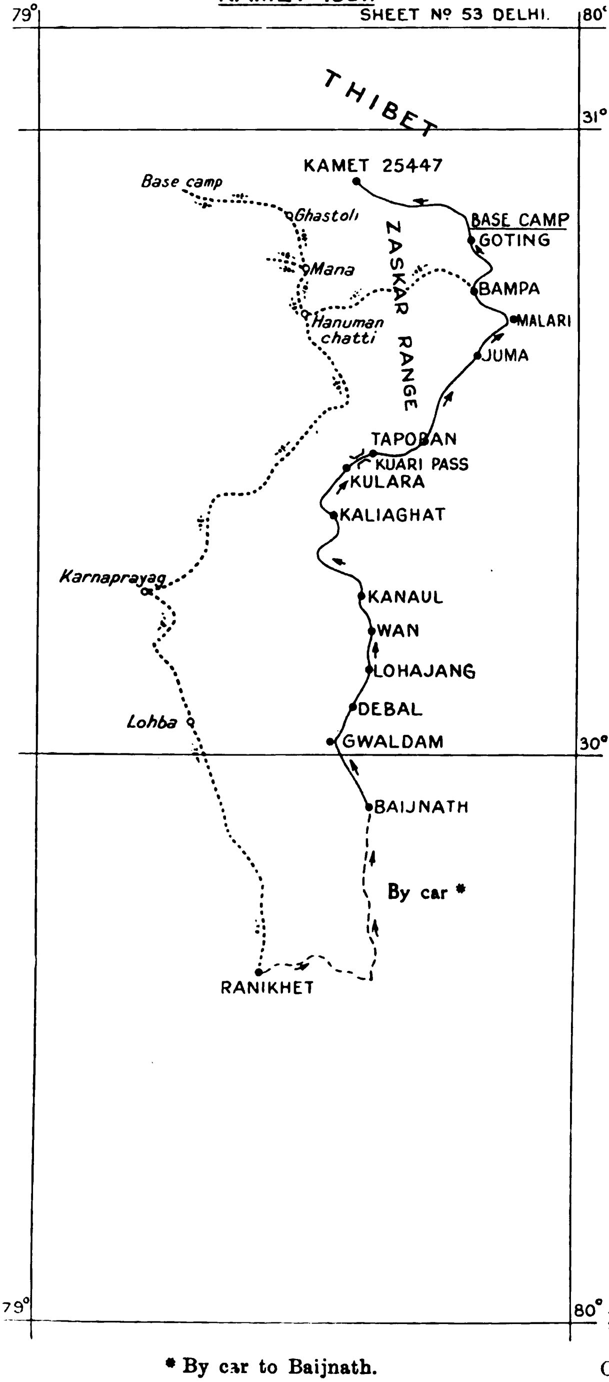
[4] Army Form A.F.I. 1247.

[5] Army Form A.F.I. 1239.

ON AND ABOUT KAMET—1913.

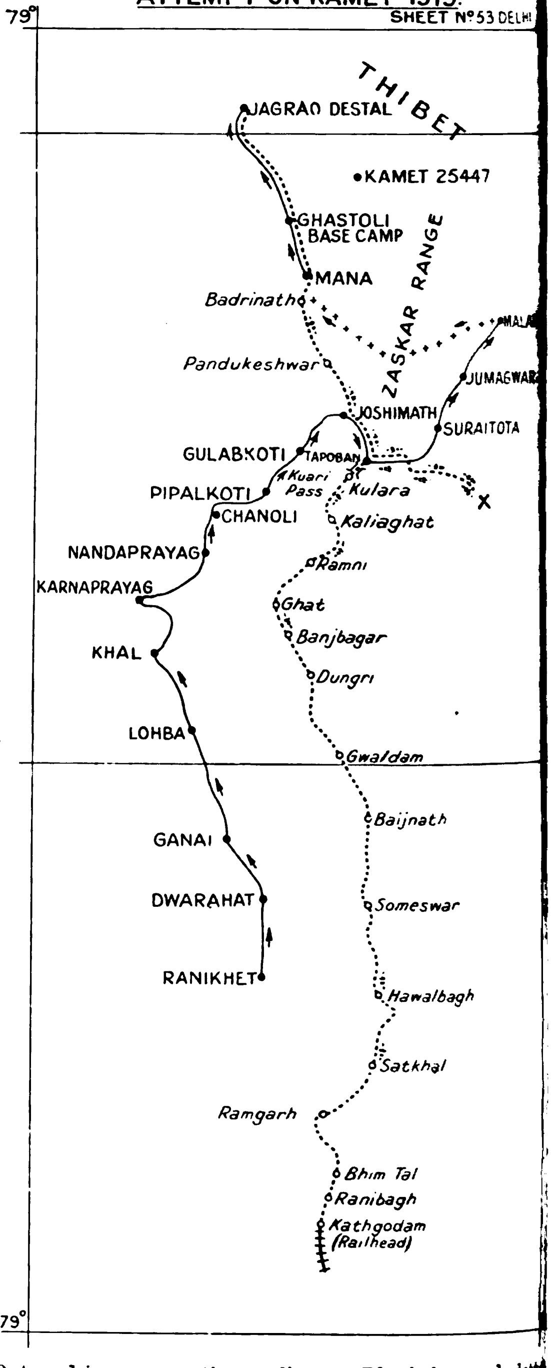
By Major C. H. H. HAROLD, O.B.E.
Royal Army Medical Corps.

KAMET 1931.



* By car to Baijnath.

ATTEMPT ON KAMET 1913.



Outward journey, continuous line. x Bharhal ground, dotted line above Kulara

Reversing the last two figures of this date, the daily paper is opened and the bold black type of the headlines announces the downfall of yet another of Nature's strongholds—Kamet. Later, marvellous reproductions of photographs taken during this fine achievement appear in the Press and notably one from the Kuari Pass which is crossed by all who claim closer acquaintanceship with this enormous mass lying astride the outer boundary of Thibet.

To those who have served in India, these pictures revive recollections and resuscitate longings once again to gaze upon the unfading beauties of the eternal snows. To me they hold a peculiar interest so that I feel drawn to recount an unchronicled attempt on Mount Kamet which was made by two gallant officers, Captain Todd and Lieutenant Slingsby, in May 1913, and with whom I had the privilege of being associated. The story is told from memory, but a memory on which the incidents of the adventure were very clearly and indelibly imprinted.

Was it not facing the above panorama twenty years ago that as a care-free subaltern I shared camp with these two, and within a few brief months we were all claimed by, can we say, a Greater Adventure from which one only was destined to return.

Here, with a partially paralysed Slingsby under my care for a full week, I saw the sun rise and set upon this gorgeous scene. Afterwards, the memories of this picture were so strong that the prints resulting from the snapshots taken with my small Kodak could scarcely be looked upon without exciting extreme dissatisfaction. I still recall Todd's remarks regarding the necessity of a telephoto lens and the annoyance I would feel when the films were developed. Still, for eighteen years the photographs of this trip, together with maps, a small diary containing records of marches, daily expenditure of food and money, accompanied me in my movements about the world, but now all that remains are the head of a single bharhal and a replica of the Badrinath image in silver, wrapped in its yellow silk, presented to me at the time by the Rawal Sahib of Badrinath.

It is now necessary for me to disclaim any pretensions to being a mountaineer or to have taken any real part in the plans or arrangements for this expedition, since my inclusion in it was entirely fortuitous.

My interest in the affair dated from the cold weather of 1913, when it was noised abroad in Ambala that a Captain of the 1/6th Gurkhas, one Todd, with a reputation as a climber and shikari, was proposing to set out on a mountaineering expedition. Later, it was suggested to me, via the late Dan Corbett, of the Corps, that my services would be appreciated on such an undertaking. A visit to the Officers' ward at the Station Hospital followed, and there I found Todd hard at work checking lists by the light of the ward oil lamp, since he had been admitted to hospital for an injury to his right knee sustained in a cycling accident. I represented that my mountaineering experiences were limited to vacations spent on the Cumberland fells and pikes and hills of Wales and that the highest mountains I had seen were the Murree Hills from the 'Pindi Golf Course.

After learning that the objective was a mountain in Garhwal and that there were good prospects of shooting, I crossed the road to the Sirhind Club where I met Corbett, and over a couple of L. C. May's agreed to ask my C.O.'s permission when a suitable occasion presented itself.

The following morning I paraded in the office in front of Lieut.-Colonel, now Major-General, H. Carr, C.B., who fixed me with his usual early morning glare whilst in grim silence he listened to my application. "I suppose you mean you would like leave in the months you have mentioned?" "Umph, well I don't know whether you will come back alive, knowing nothing of the country or the language, but you might as well go as you will come back fitter than if you spent your leave in Naini or Mussoorie or some similar place." This was rather amusing seeing that "Old Juggernaut," as we called him, was Commodore of the Naini Yacht Club. Having obtained what was an unusually gracious response to my request, I made a hurried departure before he could think of something that required doing or which I should have done, and also because his interviews with juniors usually wound up in a tirade on the deficiencies of the present-day officer. Still, I learnt later that the Colonel's gruff manner concealed a very warm nature.

Preparations.

Nothing would satisfy Todd but that I should spend all my waking hours, when not on duty, in preparing for the trip. "He would soon have me in the way of moving on the hills and get me accustomed to the use of of ice axe and rope." Could I use a rifle? Every person must be capable of contributing in bulk to the pot as only a certain amount of stores could be carried. This entailed attendances at the ranges until satisfactory groupings were attained.

A pair of B.I. boots for the marches and nailed boots for the Hills. As it was impossible to procure Alpine boots, Cawnpore was called upon to supply this deficiency and their arrival gave occasion for a typical outburst from Todd. Still, it was the best that could be done, but as events proved, their use was not devoid of danger. Next tentage. A nominal forty pounder tent for camps, bath, ground sheets and sleeping bag. A leather yakdan for kit, viyella shirts, grey flannel shorts and a good woolly. I was already in possession of a poshteen, Burberry, suitable gloves, pantaloons, Cawnpore topee, Kashmir hat, puttees, solaro coat, heavy winter underclothes and pyjamas, and for wear after the day's work, tweed jacket and flannel bags. In this way I found myself translated from the placid backwaters of laboratory work into a veritable spate of mountaineering.

It now transpired that Todd's partner in this venture was Lieutenant A. M. Slingsby of the 56th Rifles, Frontier Force, and that both combined a natural aptitude for their profession with a passion for climbing. Slingsby had been on Kamet before, and Todd's last venture in India lay, I believe, in the Karakoroms. The latter had spent his home leave the

previous year climbing in Switzerland, but chiefly in ordering stores and equipment in England and making all the necessary preparations for this undertaking. A comprehensive range of mountaineering equipment, including Whymper tents, aneroids, pedometers, etc., was available.

As physical training officer of his regiment, Todd personally trained many of his men in mountaineering as a special branch of mountain warfare, and his main object in attending the course at the Ambala Central School of Physical Training was the attainment of the highest degree of physical fitness. He was a disciple of Colonel (now Brigadier-General, retired) the Hon. C. G. Bruce and Dr. Longstaff, the former being an officer of the same Corps and stationed in Abbottabad with him. Looking back, it certainly appears that for those days the general arrangements, stores and equipment were as near perfect as possible, but up to this time I had little conception of the amount of work and thought that the intricacies of bandobast called for. The main bulk of the stores had been packed by the Army and Navy Stores, Victoria Street, London, in venesta cases of three-ply wood. Loads ran from forty to sixty pounds, as weights over these were considered unwieldy, conducive to losses by falls and greatly hampered the mobility of the porters or coolies. Each third kilta, or load, contained additional food articles which were not required as regular issues, and in each kilta was a list which tallied with a general tabulated stock list. Todd was the treasurer and paid all personnel and general expenses, whilst I was to be responsible for all stores and messing expenditure.

Both Slingsby and Todd from their past experience knew exactly what local supplies were available in the field of operations, and in obtaining these they had the co-operation of their orderlies and trustworthy personal servants, the main intermediary being the State chapprassi. The usual Indian troops bag rations of rice, ghee, atta, dhal, ghur, etc., were handed over to the subordinate staff under general supervision. They realized that the best utilization of these was to their own advantage and no encroachments on our supplies were permitted. Although our stock nowadays might be considered somewhat restricted in amount, it provided an excellent variety, and whenever possible, articles of Indian origin were invariably included.

The stores included: Flour (Delhi) and baking powder for bread making, etc.; dried fruits—apple-rings, apricots (Kulu); a small quantity of dried vegetables and meat extract, tins of meat, tongue, bacon, fish (various), sausages and cheese, all in limited amounts, a generous allowance of Lyle's golden syrup, Quaker oats, soup packets, small tins of jam, condensed milk (limited), sauces, curry powder, powdered ginger, sago, cocoa, chutney, essences, condiments, a few biscuits, tea and tea tablets (for emergency use), coffee essence, tinned cocoa and milk, one tin of cake for a supreme occasion—but we ate it at Joshimath for reasons unknown—macaroni, candles (few), butter (Ahmadabad), butter (Ambala dairy), and some butter (Polson's), cornflour, arrowroot. There was a good stock of

sugar, the issue of which was carefully supervised, as the staff rations included ghur. Tinned fruits, being heavy and bulky, were excluded, as were all supplies in jar or glass containers, with the exception of sauces and Camp coffee in straw envelopes. Rice and dhal for curries and soup were drawn from the bag rations. We each carried a small stock of chocolate (Mexican) and minor toilet requisites for personal use.

Having had experience of scurvy in civil hospitals, chiefly derived from sailing ships, I was pleased to note, in those days, the inclusion of lime-juice amongst the case bottle goods, which also comprised a generous stock or pre-War liquor, whisky, ginger wine and rum, which now, like our currency, is unfortunately debased.

Under cooking facilities were a full range of cooking pots and kettles packed in a raw hide hill type kilta. A supply of charcoal was carried, and this and other minor commodities, such as salt, were replenished as circumstances permitted. The store kiltas also held a primus stove with spares reserved for use on the snows.

The only criticism of the rations that might be permissible is that they did not allow for a protracted stay upon the snows, and, if this had been contemplated, a shortage of the protein and milk supplies would have ensued, but the adoption of rush tactics by Slingsby, recourse to shooting for the pot, and the utilization of local milk supplies brought in by the chapprassi, obviated this. In regard to the very necessary fresh food, I was informed that reasonable issues of fresh meat could be maintained, that a certain amount of potatoes, (?) onions, and very occasionally small amounts of fresh fruits were obtainable in places.

In the light of post-War standards it is with diffidence that I detail the simplicity and paucity of medical supplies, but Todd had rather a low opinion of doctors, *qua* doctors, and considered that with his experience, he was above the average himself. He did not favour the carriage of loads of physic, and further, in an emergency, we might call upon the Civil Dispensary at Joshimath. He rightly held that if a man were fit he did not require physic, and his maxims for these occasions were : (i) no jungly food ; (ii) no doubtful liquor ; (iii) good cooking.

My requirements were therefore restricted to a few bandages, a few cartons of compressed cyanide gauze, lint, hydrarg. perchloride tablets, quinine tablets, No. 9 pills, calomel, tincture of iodine, half a pound of pot. permang. for drinking water, etc., castor oil, chlorodyne, opium pills, a few Dovers and acetylsalicylic acid powders, a few skin sutures and catgut ligatures, surgical needles, a bottle of cocaine and adrenalin, a high-pressure (German) local anæsthesia syringe, a hypodermic case with one dozen tubes of various hypodermic tablets, a small pocket surgical case, the official Army pattern pocket case, vaseline, dusting powder, boric acid, some yellow ointment, mag. and soda sulph., mixed, a stethoscope and a stopwatch.

As events proved, my supplies were quite inadequate for the general needs, but, if I had taken up a small dispensary, it could hardly have coped

with the demands of the hillmen, who, hearing I was a hakeem sahib, importuned me at every turn. As it was, Todd also carried small quantities of his favourite poisons, and these came in useful in times of stress.

The two people who took the greatest interest in these preparations were the hospital writer, Raja Ram, and the hospital storekeeper, a high-caste Brahmin, who regarded my departure to these holy regions with undisguised envy. The latter proved most useful in obtaining camp cutlery and Cawnpore towels, sheets, table-cloths and table napkins.

Now, the time had simply flown; any gaps were filled in with lessons in Hindustani from the regimental munshi; and the final purchases of cartridges and lethal ball for my 12-bore, and rounds of ammunition for my rifle, completed the arrangements as far as I was concerned.

The chapprassi had been engaged and the shooting passes obtained through the District Commissioner, Pauri, and as Slingsby was pressing for an early departure, Todd was impatience personified.

His accident had resulted in a laceration of the skin on the outer side of his right knee, and the bruising of the patella set up a synovitis of the knee-joint. Later, the outer side of his leg had been explored, but with the oncoming hot weather the healing of the skin was extremely slow. He had been out of hospital, but was difficult to control.

The stores had been consigned to an agency in Ranikhet, and it was now agreed that Slingsby should pick up a share of the stores, and that we should follow as soon as possible and join forces up above.

About a week later, in early May, Todd and I left Ambala by the night mail for Kathgodam, taking with us a little dressing and lotion for his healing scar, since now it was obvious that a night or two in the cool would immediately work a change.

Travelling to Ranikhet by mail tonga, we proceeded to sort out our stores and make up the final loads and to pitch, air and strike the canvas. Whilst awaiting our arrival, Slingsby had filled the kiltas in accordance with the schedules, and these were checked. This occupied two days, and Todd's leg now only required a gauze dressing. It was arranged that as the first marches were extremely hot and trying, and to avoid any unnecessary strain on Todd's leg, ponies and mules should be used for the opening stages.

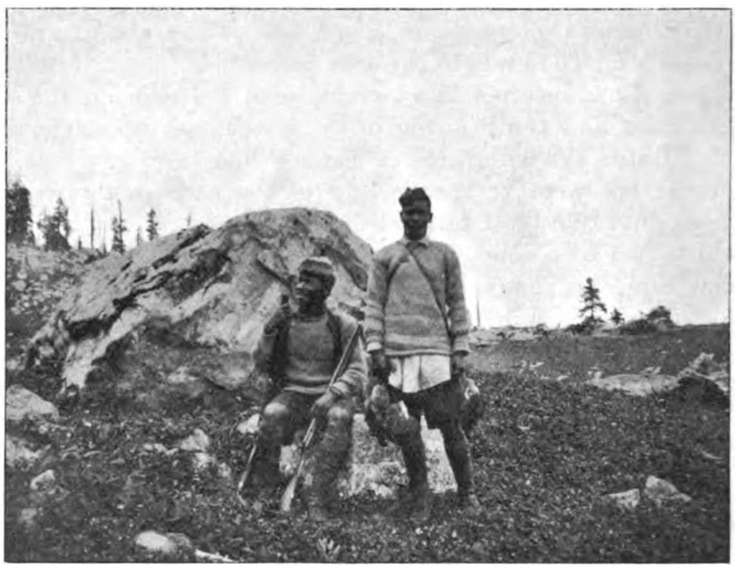
Now all was ready down to a new kerosene tin for the sahib's bath, and the chapprassi, complete with sash and State arms in brass, was marched in. In a few well-chosen words he was told what his duties were to be, what he might expect if things ran smoothly, and, continued the frontier-wise sahib, what he could imagine would be his lot at the hands of the Gurkha soldiers and the District Commissioner if trouble with the coolies or over local supplies arose.

The chapprassis' pay is fixed by the State, but apparently they usually made demands ascribed to the increased cost of food in the hills and the rigours of climate and, in addition, the mentality of a mountain-climbing

sahib was considered as a thing apart. On this occasion it was a speechless, deflated chapprassi, with a curiously anxious expression on his face, who left hurriedly to make advance arrangements murmuring "Dude, coila, merghi, ăālo," which demands the cook had conveyed to him in a sibilant whisper.

With the prospect of two months most intimate companionship in view, our little party was now left face to face and proceeded to take stock of each other and make mental assessment.

Todd, the leader, about five feet eight inches in height, broad of build, round face with a good jaw, good eyes and colour—a man who could somersault or walk on his hands down the ante-room, or walk his Gurkhas off their feet, and whose trust in him was absolute. He was a charming



Havildar Dunlall and Naik Chunder Singh, at Kaulara.

companion, widely travelled, and possessed a fund of Himalayan and shikar lore.

Both the havildar and the naik, who were much taller and bigger than the average Gurkha, had just completed a full physical training course with Todd and were graded as instructors. The havildar was a man in his prime, a little taller than Todd, broad of back, and capable of carrying a load in the hills against any coolie. He was a veteran mountaineer and accompanied Longstaff on his climb of Trisul (23,406 feet), which, until recent years, was the mountaineering record.

The naik, Todd's batman, constantly smiling, was still taller, wiry, long armed and active as a cat.

Next, the most important man of the party was Todd's bearer, really cook—a Goanese with a large peaked English cap worn at one side half

concealing his small lined face. His countenance was usually shrouded in gloom as if he bore the sins and cares of a dozen ordinary men. Despite this, his great cronies were the havildar and naik, and in camp peals of laughter could be heard coming from the cook tent. The appearance of Todd or myself, however, was quite sufficient to produce a kaleidoscopic reversion to his normal condition of depression. He frequently marched sockless, with his Army boots unlaced, shambling along mile after mile with the advance coolies. On arrival in camp out of the disorderly unappetising medley of his daily stock box he produced as good a meal as anyone could wish. He was a great cook and I look forward to the day when I meet a better.

Todd's black cocker spaniel which was a perfectly trained field dog. Myself, the tyro of the party, twelve stone, fairly tough after a winter's rugger with the Duke of Wellington's Regiment, and at that time still capable of an odd burst in top gear. My bearer who was a cheerful, helpful, spotless individual, also no mean cook, and from whom avarice oozed. Lastly Pinkie, a white bull terrier bitch, pedigreed but I fear with bar sinister, frequently blood-stained. She had adopted me one memorable night, after taking refuge in my room with the Mess joint. Pink of mouth and habits, of an affectionate nature and prone to battle.

The Start.

Our outward journey was via the pilgrim route and already rumours had reached us that considerable disease prevailed along it. We set out at crack of dawn, with ponies and mules, reaching Dwarahat where we spent the night. Todd had marched and ridden in alternate spells and no untoward trouble with his knee arose. Food had been prepared in advance for us by the cook and the routine of the marches was established. The rule of the road being that just before break of day we were awakened with gunfire tea, shaved or not—depending upon the state of the skin on our faces. Water bottles were filled with boiling water and we breakfasted whilst camp was being struck. The cook and my bearer with an advance coolie then moved off, followed by the main body of the transport. The havildar and naik superintended the apportioning of the loads. The kazana, or cash box, in Todd's suitcase, travelled with us and was carried by a special coolie. We carried our guns during the early parts of the morning marches and frequently we moved off before the main body, listening for the early morning call of the black partridge, or kept an eye open for the presence of sisi, chikkor or pigeon. As birds frequented the route looking for grain, etc., few mornings passed without some useful addition to the larder.

Todd proved a first-class shot, and to see him get a perfect right and left at black partridge flushed from a bush on the reverse slope of a hill was an absolute joy.

On the second day a double march was made, via Ganai to Dhargad, and

here we dismissed our ponies and mules and adopted the normal mode of progression with coolies. In the vicinity of Ganai we had noted a number of funeral parties, and the Gurkha orderlies drew our attention to these, but Todd reassured them. Our next march was to Lohba and on to Khal. By this time the chapprassi was gently breathing of difficulties *re* coolies and that cholera was present. We now passed little villages, quite deserted, Indian food shops with the ashes still under the tawa, the cooked gram and jillabis all piled and exposed for sale, but untouched as there were no bunyas to sell. It appeared as if all had fled hurriedly, and in many places along the route it was noticed that the local inhabitants had abandoned the villages and taken to the jungle. Todd and I discussed the position and orders were given that none of the followers or orderlies were to eat food near villages where flies abounded in their millions, neither were they to purchase any article of food or drink. Milk for tea was to be boiled and they could have tea whenever possible. Their water bottles, like ours, were to be filled with boiling water and cooled by the evaporation of water off the felt covers. As far as the cooking utensils were concerned, these were to be cleaned with cookhouse ash only, and at Karnaprayag we purchased a big brass degchi. The bunyia who sold it was in such a state of fear that he was too preoccupied to increase the price unduly, and refrained from haggling when Todd cut him down.

Although up to date I had not seen cholera, but recognizing the importance of the old adage of the four "F's" in infection, from now onwards before a meal, all plates, mugs and cutlery, enclosed in the table cloth and napkins, were laid before us steaming, after immersion in boiling water in the large degchi.

We had carried a stock of ration bread from the Government bakery in Ranikhet, and I was interested to note the method our cook employed to render it fresh for use. Wetting the outside of the loaf it was placed in an empty degchi and covered with the lid. The degchi was then completely covered with hot ash and the loaf rebaked. When the stock was finished, bread was made by using baking powder and sour milk, and I cannot recollect any occasion when bread was not available and a substitution of chapatti made.

A Rock-climbing Feat.

For a short way our marches had followed the course of the Pindar river, and early one afternoon the Gurkha orderlies, to whom the slightest movement on a hillside was perceptible, drew Todd's attention to ghooral on the rocks overhanging the river, on the opposite bank. Todd hinted that the range was a little long and that afterwards the chances were that the quarry would fall into the stream and finally they could not be retrieved. However the havildar and naik seemed especially keen to obtain fresh meat and prevailed upon Todd. Taking cover behind some rocks, as near to the stream as possible, Todd fired and missed. The animals apparently attributed the report to falling rocks but stood up on the lookout and so

gave an improved target. Putting up his sights Todd with his second barrel brought down a ghooral which fell off the rocks short of the stream. We then sat down to watch the havildar, who, crossing the stream lower down by a so-called rope bridge which in its simplest form, consisted of two ropes one above the other tethered from bank to bank. He then climbed along the bank until he came to the projecting mass of rocks. Here, he removed his boots and with fingers and toes made his way across the rocks, gaining the recess upon which the beast had fallen. Then binding the ghooral on his back with a pagri borrowed from a coolie, supplemented by a brightly coloured scarf, which these gurkhas use as headgear when not on duty, he then climbed on to the rocks and proceeded to repeat the feat. The carry over was not a matter of a yard or so, but with slight breaks some twenty yards or more. The naik, the coolies and ourselves watched the effort with bated breath and even the coolies, hillmen though they were, became too engrossed to chatter, and when the havildar reached the hill-side all acclaimed his efforts with shouts of "Shahbash, shahbash." This operation took some time since each foothold and grip had to be tested beforehand, and frequently rotten pieces of rock under strain crashed below into the rocky channel. The slightest slip would have resulted in a fall of hundreds of feet, and even if the havildar had been fortunate enough to escape striking a rock, he was still hampered by the ghooral and its lashings. Later, I had every reason for being profoundly thankful for this man's almost superhuman skill.

That evening it was suggested that a little roast ghooral might not come amiss, but we were informed that such meat, in the case of sahibs, set up diarrhœa, and so we contented ourselves with a little of the liver and continued with the merghi (chicken) and titre (partridge) as before.

The Pilgrim Route.

At Karnaprayag the Pindar River meets the main tributary of the Ganges, viz., the Alaknanda, and as we turned up to follow its course we realized that we were now in the same basin as our objective. During the day-time it was still extremely hot, the road rough but better defined and much busier. Since leaving Ranikhet our route had been joined by numerous side paths, carrying their quota of pilgrims, and now we had joined the main body, all finding their way up from Hardwar. As we marched up the valley the nights tended to get colder and colder. The pilgrims, like ourselves, except those who travelled all day as part of their penance, moved from stage to stage in the early morning, and as the various parties passed each other the cries of "Ram, Ram" filled the air. Certain ecstatics moved rapidly and unseeingly along the rough road, singing or repeating prayers aloud. Blind and ragged beggars led by small children, and numerous lame people were frequently encountered, since Badrinath is reputed to have a marked curative influence on such cases, and miracles are of daily occurrence. Yogis and sādhus, some garbed in yellow, others

with matted hair, naked save for a strand of cloth, and certain others with evil and villainous faces all plastered with mud and white with ashes, were common. A few of these, whose thoughts were more on this world, noticing our interested looks, occasionally threw an amused and challenging glance in our direction, but in the main this class of man usually passed studiously oblivious of our presence.

Caste marks were everywhere very much in evidence, and here an æsthetic high-caste Hindoo in poor, but spotless, clothing pressing onwards up the valley with his family, meets a stout and blatant bunyia, with high stomach and waddling gait, dressed in a bright silk coat, who moves to one side out of deference and salaams in silence. Up to now the latter had been haggling and chaffering with a wayside sweetmeat seller at the top of his voice, but at the approach of the higher caste his raucous voice is hushed. It is easy to imagine how hardly such a man acquired virtue by being compelled to walk mile after mile and to endure with equanimity the imposition of the most extortionate prices.

And so from stage to stage at our approach, umbrellas are lowered and greetings are exchanged in which we take the initiative. "Salaam Buddha." "Salaam Huzzoor." "Salaam babu," "Good-day, Sir." "Salaam jehwan," and so forth.

On one particular day, when through dread of cholera, we were held up by lack of coolies, I watched with great interest the ever-changing throng, men of all shapes and shades of colour, from the light hillmen with the refined Rajpat type of feature, to the coarser one of the Dravidian. Here some Garhwalis who greeted our Gurkhas and saluted the sahibs. Next, some Bhootias and other hillmen, lastly two parties of Thibetans. In after years in a café in Turkestan, surrounded by a bizarre assembly, it crossed my mind that somewhere I had seen a similar medley of features and these impressions were vividly recalled, but in the latter case the predominance was Mongolian.

(*To be continued.*)

Editorial.

ON THE STATE OF THE PUBLIC HEALTH.

THE Annual Report of the Chief Medical Officer of the Ministry of Health for the year 1932 is of particular interest as it contains much information on the effect of unemployment on the national health, as well as the usual sections devoted to the general work of the Ministry.

The Report commences with a section on the state of the Public Health in England. The estimated mid-year population of England and Wales in 1932 is given as 40,201,000; but the age distribution derived from the Census of 1931 is not sufficiently complete to enable sex-age estimates to be prepared for mid 1932. The estimated population by sex and age in 1931 is again repeated from last year's Report.

The natural increase of population in the last five years has fallen from 200,000 to 130,000. It is estimated that if there be no improvement in the future growth of the population the births and deaths will gradually become equal and thereafter the deaths will be in the ascendancy. At present rates the total population will have attained or passed its maximum by the middle of the century.

The birth-rate was 15·3 per 1,000 living, the lowest on record. The death-rate was 12 per 1,000 compared with 12·3 in 1931 and 21·4 in the decennium, 1871-1880. The five principal causes of death were: (1) Diseases of the heart and circulatory system; (2) cancer; (3) bronchitis, pneumonia and other respiratory diseases; (4) diseases of the nervous system; (5) all forms of tuberculosis.

If the deaths which occur during a man's working life, viz., between the ages of 15 and 65 years, are alone taken, then the order becomes different and diseases of the heart and circulation take first place, then follow cancer, all forms of tuberculosis and diseases of the respiratory organs.

During the last forty years of the nineteenth century infant mortality in England and Wales was almost stationary, whilst in the present century it has been reduced by more than half. The decline has been greatest at the age of 3 to 6 months. The most important decline in recent years has been in bronchitis and pneumonia, and in diarrhœa and enteritis. In 1900, 142,912 children died under 1 year of age, and in 1930 the number who died had fallen to 38,908. Sir George Newman considers that this astonishing saving of life is largely due to increased maternal care of the new-born child. There has been an improvement in the external environment of the child, sanitary, social and domestic; but after all is said the environment of an infant under 12 months of age is mainly its mother. The State cannot save these children, but it can help their mothers to save them. Sir George Newman says that many weakly and perhaps even

defective children will be saved, and this brings new problems. It is futile to save these lives unless they be properly reared and equipped for healthy and productive citizenship.

The second section of the Report is devoted to a discussion of the effects of unemployment on the national health.

In an attempt to estimate the effects of unemployment a number of factors have to be taken into consideration. There is first the direct effect of unemployment on the worker and his dependents, and the indirect effect on the physical well being, and especially on the minds of the general population through fear of unemployment.

Unemployment may have a direct effect on the workers in various ways. There may be : (*a*) Want of an adequate diet ; (*b*) loss of bodily power through idleness or through illness which may render a man unfit to resume his former employment ; (*c*) inadequate bodily functions, such as digestion, or even mental neuroses, produced by worry and anxiety ; (*d*) actual excessive sickness.

Much of the effect of unemployment cannot be analysed, and we have to be guided by the broad facts of sickness and mortality. The surest of all tests of grave injury to the population are the mortality returns.

An examination of the returns for England and Wales shows that the total death-rate has been steadily declining since 1871 ; the infant mortality has continued to decline since 1901 ; and the great constitutional diseases, such as tuberculosis, which have a special social and domestic significance, have declined proportionately in the last ten years. These returns indicate that there is no evidence from mortality in support of exceptional physical deterioration in recent years owing to social conditions. Nor is there any general increase of mortality among the unemployed themselves and their dependents, or even in the depressed areas as a whole.

A study of the returns from administrative counties and county boroughs which have a claim on the special Exchequer Grant of £440,000 provided to assist distressed areas in the financial year, 1933-34, indicates that in districts where unemployment has pressed most hardly the genera health has been well maintained, and that most of the areas have shared with the whole country in a falling mortality. For instance, in Durham the death-rate was 13 in 1929 and 11·9 in 1932 ; in Barnsley, 15·2 in 1929 and 11·8 in 1932 ; in Merthyr Tydfil 14·2 in 1929 and 13·7 in 1932 ; in Hull 15·29 in 1929 and 11·8 in 1932.

The Medical Department of the Ministry of Health have sought in the official mortality returns for any positive or negative evidence on the subject. For this purpose an examination has been made of the mortality rates from 1921 to 1931 from two urban groups of five County Boroughs and six County Boroughs respectively, with high and low unemployment incidence. In the five seriously affected areas three, being contiguous, were grouped together. If the standardized death-rates of these

("bad" towns) in 1921 are taken as 100 the standardized rates in 1931 are found to be 98, 84, 96, an average improvement of 7·3 per cent. The corresponding figures for the six less seriously injured towns ("good" towns) are 100, 92, 93, 97, 100, 100, giving an average improvement of 3 per cent. Using data for women in the same way, the "bad" towns had an improvement of 11·3 per cent and the "good" towns one of 8·7 per cent. This comparison does not reveal any disadvantage on the side of the "bad" towns.

The rates of mortality in each area and in each of the nine groups were also scrutinized in detail so as to determine whether the trend of mortality in any one age-group could be found consistently unfavourable in one group and favourable in the other. It was not found that in any one age-group the changes in the "bad" towns compared unfavourably with those in the "good" towns.

Evidence of malnutrition was then sought for in the Annual Reports of Medical Officers of Health and the School Medical Officers. The most susceptible index of malnutrition in a community and one available to these officers concerns children of school age. When school inspection began in 1908, malnutrition of school children was evident, and in 1910 reached from 15 to 12 per cent. Since then, as a result of child welfare work and the provision of meals in schools, the figure for malnutrition for the whole country has fallen to about 1 per cent; it was 1·06 in 1930, 1·12 in 1931, and 1·07 in 1932. The height and weight of school children have definitely improved during the last ten years.

A special review in 1932 by the London County Council showed that among 180,905 children inspected, the definitely ill-nourished children found were less than one in 6,000. Dr. Butterworth of Lancashire, in 1932, reported that the prevailing economic conditions had not seriously affected the health of the community. Dr. Fraser of Liverpool stated that the nutrition of school children for the five years, 1927-31, had been better than for the five years 1921-25. Reports from other medical officers are couched in the same vein. Most of this evidence concerns child life, which if not protected quickly responds to an unfavourable environment.

For evidence as to the condition of the population above 16 years of age, recourse must be had to the National Insurance Scheme. Regional medical officers were asked to report whether there was any evidence of excessive sickness among insured persons attributable to unemployment, and in particular any increase or decrease of anæmia, malnutrition, diminished capacity for work, or slowness of recovery reaction among men and women.

Taking the country as a whole the evidence points to the conclusion that, except in certain localized areas and in some special and restricted groups, there has been no general excess of sickness, ill-health or physical incapacity attributable to unemployment. But it is stated that in areas where unemployment has been severe and prolonged some physical

impairment is noted among men normally engaged in heavy labour, and a tendency to mental depression bordering on neurasthenia is noted among some of the older men who have large families dependent on them. Amongst women, especially in Newcastle-on-Tyne and in Aberdeen, anæmia was reported by some observers, but on investigation this was found attributable to frequent pregnancies, prolonged lactation, etc., rather than to under-nourishment.

In his conclusions Sir George Newman points out that we cannot fully assess the *social* results of unemployment and social depression. We can only measure the obvious end-results, viz., sickness returns and deaths. An absence of evidence of physical impairment or increasing mortality does not necessarily mean that all is as it should be. For we cannot know what present conditions may engender or what seeds of "a harvest all of tears" are being sown. Though the medical reports recently received contain no signs of widespread physical degeneration, there is an undercurrent of fore-warning as to the possibility of risk of mental instability in the adult man and prolonged under-nourishment of women and children. The psycho-neuroses are not fanciful maladies; the overstrained mind is quite as susceptible of disease as the overstrained or underfed body.

In the section of the Report dealing with general epidemiology, there is an interesting note on the treatment of post-vaccinal encephalitis by the injection of serum from a recent vaccinee. A case of post-vaccinal encephalitis occurred in 1932 and another in 1933; both cases were very severe, but recovered after the intravenous injection of blood-serum. In the first case the serum was taken from a donor who had been vaccinated three and a half years previously, in the second case from an adult vaccinated three months previously. The Report states that this method of treatment should be more widely known, and its adoption should be seriously considered as soon as the presence of post-vaccinal encephalitis is suspected.

During the epidemic of measles in London an investigation was made under the auspices of the London County Council into the value of "adult" and "convalescent measles serum" in the protection of contacts. Of 2,020 children, 680 received injections of convalescent serum, 130 received adult serum, and 207 no prophylactic inoculation. Of the untreated children, only 25 per cent escaped the disease, while of those receiving the convalescent serum 90 per cent did not develop the disease, and of those receiving the adult serum 76 per cent were free from the disease. Of the uninoculated children, 70 per cent suffered from an unmodified attack of the disease, while only 3 per cent of the inoculated so suffered. In one group of children receiving the convalescent serum it was found that when this was given after the fifth day following exposure to infection more than half the children developed mild or modified attacks. The preventive dose for children under 3 years of age was 10 cubic centimetres, for older children a

dosage in cubic centimetres equal to the number of years of age multiplied by four; the serum should be given within the first five days after exposure to infection.

In May, 1933, the Medical Research Council issued a report by Miss Woods on a statistical study of scarlet fever during the past thirty years. Miss Woods arrives at the conclusion that there has been no notable reduction in the incidence of the disease as a result of hospital isolation, or, indeed, of any other method of public control. A similar view was expressed by the Ministry in their report on *Some administrative aspects of scarlet fever* issued in 1927.

The mortality from whooping-cough has diminished, the rate recorded in the decennium 1921-30 being only one-third of that recorded in the period 1861-70. The disease, however, still remains an important cause of child mortality; the mortality being slightly in excess of that due to measles and equal to those of scarlet fever and diphtheria put together.

Stocks and Karu have made a statistical investigation into some epidemiological features of whooping cough in four London boroughs. They conclude that by the tenth year sixty per cent of the children in London have acquired the disease; the bulk of the remaining forty per cent escape by the acquisition of a temporary immunity during epidemics, and the remainder by an inherent immunity. The latent immunity apparently lasts about one year, instead of two or three as in measles.

Gardner and Leslie have endeavoured to expedite the diagnosis of whooping-cough by exposing plates of the Danish modification of the original Bordet-Gengou medium when a fit of natural coughing occurs. After seventy-two hours incubation at 37° C. the *Hæmophilus pertussis* of Bordet and Gengou is recognized by colony appearance, cell form and the agglutination test. From the results of 107 tests in 82 cases, Gardner and Leslie believe that by this method it is possible to accelerate the diagnosis obtainable by clinical methods and to supply one when clinical methods fail. The authors believe that their results of vaccine treatment will be improved by using a vaccine of which *H. pertussis* in a virulent stage is the chief antigen. The causal relation of *H. pertussis* to whooping-cough is, however, not everywhere accepted; many workers believe the cause is an invisible virus and that *H. pertussis* is only a secondary invader.

Sir George Newman, in previous reports, has called attention to the variations in the incidence and mortality of diphtheria. In some towns such as South Shields this incidence was only 0·39 in 1930 and 0·17 in 1931; while in Southport, a largely residential town, it was 2·55 in 1930 and 2·26 in 1931. A complete explanation of these variations is not forthcoming; they may be related to an immunity acquired by numerous minimal infections. In densely populated industrial centres there is a higher

percentage of Schick-negative children than in sparsely populated residential districts; the higher figure is not a natural immunity, but the result of minimal infections acquired over a long period of time. It is estimated, however, that artificial immunization has no influence on the general incidence and mortality of diphtheria unless there are thirty-five to forty per cent of immunes in children under school age.

The type of diphtheria in 1932 was on the whole mild, but there were groups of cases which did not seem to respond to antitoxin treatment. Schweitzer and Noel have investigated these cases and have come to the conclusion that the symptoms of diphtheria intoxication are "in large part due to secondary constitutional disturbances in all of the essential body tissues," and to counteract these they suggest that the treatment by antitoxin should be supplemented by the administration of dextrose and insulin with a view to the stabilization of the carbohydrate metabolism. The results of this treatment are stated to be promising, and further experience of it will be watched with interest.

Anderson, Happold, Macleod and Thompson, working at Leeds, have differentiated two types of the diphtheria bacillus—"gravis" and "mitis"—which appear to be correlated with the severity of the cases in the Leeds district. Allison, working in the isolation hospitals of the London County Council, and Merton in Staffordshire, have not been able to confirm the Leeds findings. It may be a local phenomenon, but the practical point that disease produced by the "gravis" and "mitis" strains yields to treatment with the ordinary antitoxin in use has been proved by Parish, Whatley and O'Brien. They found that not only were the "mitis" strains as virulent to animals as the "gravis" strains, but they produced toxins having a higher value.

In the January, 1934, number of this Journal we hope to continue our notes on Sir George Newman's excellent Report.

Clinical and other Notes.

AN UNUSUAL CASE OF CONGENITAL HYPERTROPHIC PYLORIC STENOSIS.

By Major L. S. C. ROCHE, M.C.
Royal Army Medical Corps.

Incidence in Family.—The first pregnancy ended in miscarriage, the second resulted in the birth of a boy free from pyloric trouble, the third and fourth pregnancies ended in miscarriage; the fifth and sixth pregnancies resulted in the birth of boys who both developed pyloric stenosis and were both ultimately cured by operative measures.

Such an incidence is extremely rare, the condition being most common in the first-born son. That a second case may occur in the same family is becoming more and more recognized.

The following remarks apply to the second case only, the first case in this family having been treated in Scotland. The early and careful observation in the second case was largely due to the parents' experience with the first case, the father himself being a medical officer.

Onset.—Vomiting began on the fifth day of life, i.e., as soon as lactation was properly established. The term "congenital" seems therefore justifiable in this case. The usual onset being during the third and fourth week, many believe that the condition is "acquired."

The Usual Diagnostic Symptoms and Signs.—The "cardinal" signs are given as projectile vomiting, visible and marked peristalsis and palpable pyloric thickening.

Projectile vomiting occurred one to four times a day from the fifth day onwards in spite of careful breast feeding.

Visible and marked peristalsis, so typical of the condition, was seen once only during the fourth week, in spite of frequent and careful observation.

Palpable pyloric thickening was not observed in this case partly owing to the well-developed abdominal muscles in a big baby (weight 9 pounds 6 ounces) but mainly because the thickened pylorus was too deeply situated under the liver to allow palpation.

Other Symptoms.—Wasting had not occurred before the diagnosis was made and the operation completed. The weight at birth was 9 pounds 1 ounce, and the weight at the fourth week, the day before operation, was 9 pounds 6 ounces. The child was breast fed four-hourly during the first two weeks of life. During the third week he received eight small breast feeds in twenty-four hours and during the fourth week the same with supplementary feeds of predigested Benger's food. The average total

amount of food in twenty-four hours (arrived at by test weighing) was 18 ounces.

Constipation was not a feature. There were always two to four motions a day, variable in quantity, sometimes normal in appearance but often loose, green and slimy.

Marked distension of the stomach with difficulty "in bringing up wind" was a constant feature.

Medical Treatment.—As may be surmised from the foregoing, in the absence of two of the cardinal signs, the diagnosis was anything but clear in the early stages. The syndrome of vomiting, gastric distension and green slimy stools might have been due to dietetic error. Careful breast-feeding checked by test weighing, the giving of sodium citrate before feeds and occasional doses of milk of magnesia had no effect whatsoever on the condition.

On the twentieth day of life gastric lavage twice a day was instituted. Such a measure had little effect on the condition. On the other hand, when other generally recognized signs and symptoms had failed, it eventually placed the diagnosis beyond doubt in the following manner.

During the first four days of gastric lavage, three hours after a feed no food residue was found in the stomach, though increasing amounts of mucus were noted. During the next four days there was a progressive increase in residual contents from ½ an ounce at first to 2½ ounces on the fourth day.

Surgical Treatment.—On the twenty-seventh day of life typical visible and marked peristalsis was seen for the first time and the weight had dropped by one ounce in the week. The diagnosis being established, Rammstedt's operation was performed the next day.

Immediately prior to operation the stomach was washed out and 40 cubic centimetres of saline were administered subcutaneously. The operation was begun under local novocain infiltration with the child feeding on a ten per cent glucose solution, but it was later found necessary to adminster a little C.E.2 mixture on an open mask to obtain the requisite abdominal relaxation to permit of the deep-seated pylorus being brought to the surface. The stomach was found very much distended and with walls thinned out. The pylorus was greatly thickened and of almost cartilaginous consistency.

Four hours after operation two-hourly feeds were instituted: at first 1 ounce of five per cent glucose, then 2 ounces, later 1 ounce breast milk and 1 ounce glucose solution, and by the 16th hour after operation 2 ounces breast milk. Twenty-four hours after operation three-hourly 2½ to 3 ounce feeds were resorted to, and if necessary were supplemented with the Benger's mixture noted above.

Progress.—The highest temperature recorded was 100·4° F. on the second day. There was no further projectile vomiting, though occasional vomiting occurred up to ten days after operation. The weight of the child progressed as follows :—

Day of operation..	..	..	..	9 lb. 6 oz.
1st week after operation..		..	..	10 ,, 1 ,,
2nd ,, ,, ,,	..	..	..	10 ,, 10 ,,
3rd ,, ,, ,,	..	..	..	11 .. 4 ,,
4th ,, ,, ,,	..	..	..	12 ,, 4 ,,
5th ,, ,, ,,	..	..	..	13 ,, —

Sutures were removed on the seventh day. One suture had pulled through and this area of the scar was not completely healed until nineteen days after operation.

Conclusions.—The unusual incidence of the condition in this family has been alluded to. Certain cases do appear to have a congenital origin. In the absence of certain accepted cardinal signs and symptoms it appears that diagnosis may be established by noting the progressive increase in gastric residue during gastric lavage. The operation when performed before serious wasting occurs offers an excellent prognosis; there is rapid amelioration and immediate increase in the weight.

I am indebted to Lieutenant-Colonel I. Davenport Jones, I.M.S., for his skilful surgical intervention, also to Brevet-Colonel G. G. Tabuteau, D.S.O., V.H.S., R.A.M.C., Commanding the British Military Hospital, Karachi, and to the child's father, an esteemed brother officer, for allowing me to forward this report for publication.

SNAKES IN HONG KONG AND THE NEW TERRITORIES.

NOTES FROM THE OFFICE OF THE A.D.M.S., CHINA.

[The accompanying notes on the poisonous snakes found in Hong Kong have been drawn up from notes supplied by Dr. G. A. C. Herklots, Reader in Biology at the Hong Kong University (from whom the specimens were obtained), from articles written by Dr. Herklots in the local press, and from a pamphlet on "Poisonous Snakes and their Venom," by Norman Smedley of the Raffles Museum, Singapore.]

WITH the exception of the sea-snakes (Hydrophiinæ), all the venomous snakes found in the South of China are of the Colubrine or viperine group. (Until recently the sea-snake was accounted for under the heading of Colubridæ, but has now been grouped separately.)

The Colubridæ, sub-family Elapinæ, comprise some of the venomous snakes, e.g., Kraits (*Bungarus spp.*), the Cobra (*Naja naja*) and the Hamadryad (*Naja hannah*). The latter is not found in Hong Kong or the New Territories.

It is impossible to give a satisfactory description by which the various snakes may be recognized at sight. The layman should familiarize himself with the appearance of the important species in a museum, and then would do well, when in doubt, to treat any snake as dangerous. Where possible a bite should receive the attention of a qualified medical man, and it is of great help to him if the offending reptile is available for examination and

amount of food in twenty-four hours (arrived at by test weighing) was 18 ounces.

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Sutures were removed on the seventh day. One suture had pulled through and this area of the scar was not completely healed until nineteen days after operation.

Conclusions.—The unusual incidence of the condition in this family has been alluded to. Certain cases do appear to have a congenital origin. In the absence of certain accepted cardinal signs and symptoms it appears that diagnosis may be established by noting the progressive increase in gastric residue during gastric lavage. The operation when performed before serious wasting occurs offers an excellent prognosis; there is rapid amelioration and immediate increase in the weight.

I am indebted to Lieutenant-Colonel I. Davenport Jones, I.M.S., for his skilful surgical intervention, also to Brevet-Colonel G. G. Tabuteau, D.S.O., V.H.S., R.A.M.C., Commanding the British Military Hospital, Karachi, and to the child's father, an esteemed brother officer, for allowing me to forward this report for publication.

SNAKES IN HONG KONG AND THE NEW TERRITORIES.

NOTES FROM THE OFFICE OF THE A.D.M.S., CHINA.

[The accompanying notes on the poisonous snakes found in Hong Kong have been drawn up from notes supplied by Dr. G. A. C. Herklots, Reader in Biology at the Hong Kong University (from whom the specimens were obtained), from articles written by Dr. Herklots in the local press, and from a pamphlet on "Poisonous Snakes and their Venom," by Norman Smedley of the Raffles Museum, Singapore.]

WITH the exception of the sea-snakes (Hydrophiinæ), all the venomous snakes found in the South of China are of the Colubrine or viperine group. (Until recently the sea-snake was accounted for under the heading of Colubridæ, but has now been grouped separately.)

The Colubridæ, sub-family Elapinæ, comprise some of the venomous snakes, e.g., Kraits (*Bungarus spp.*), the Cobra (*Naja naja*) and the Hamadryad (*Naja hannah*). The latter is not found in Hong Kong or the New Territories.

It is impossible to give a satisfactory description by which the various snakes may be recognized at sight. The layman should familiarize himself with the appearance of the important species in a museum, and then would do well, when in doubt, to treat any snake as dangerous. Where possible a bite should receive the attention of a qualified medical man, and it is of great help to him if the offending reptile is available for examination and

possible identification. The reason for this is that the nature of the venom, and consequently of the antidote, varies even between one species and another.

It is a common error to believe that snakes lie in wait, ready and eager to snap at the heels of passing man. Nothing is further from the truth ; like most animals they usually only attack man when provoked or suddenly disturbed, then fear drives them to their only method of defence. If they see a way of escape from a potential enemy they will take it.

ELAPINÆ.

Cobras.

Cobras in Hong Kong and the New Territories are found usually in the spring and early summer months. They are readily recognizable by the hood and its spectacle, which distends when the snake is aroused, and by the hiss with which venom is ejected, and even before ejection of poison.

Distinguishing Features.—Easily distinguishable on account of the hood posterior to the head which distends when the first segments are raised erect for striking to perhaps three or four times the diameter of the rest of the body and relaxes when the head is lowered. The Chinese colloquial name, rice-spoon head, is aptly descriptive of the head which is like the inverted bowl of a spoon.

Naja Naja Atra (*Cobra.*)

The "spectacle" is easily visible when the hood is distended. The head and neck are white or yellow underneath. At intervals of from one-half to one inch along the body are narrow bands of white or yellow, the general colouring of the body being blackish or dark-brownish. *Length,* up to three or three-and-a-half feet. *Distribution,* from sea-level to the top of the Peak. *Habits,* most active evening and morning, sleepy during the day. Young cobras occasionally enter houses though adults rarely do so. Young ones carry a considerable amount of venom, but the bite is not so likely to be fatal as that of adults. Generally the venom is less powerful than that of the Indian cobra.

Kraits.

Of the four local groups of banded snakes the kraits are most to be feared on account of the virulence of their venom and on account of their relative abundance. Fortunately, however, kraits are nocturnal snakes and only under very exceptional circumstances can they be induced to bite during the day-time. Mell, in 1928, said, "Nocturnal animals with round pupils, almost or entirely incapable of being narrowed, like *Bungarus calliophis*, seem to be temporarily blind during the day. As a result no one has ever succeeded in making a sexually mature Bungarus bite during the day, even though it is a close relative of the cobra. It possesses a very effective poison."

Gadow, in the "Cambridge Natural History," writes: "The krait

seems to cause more deaths in India than any other snake since it is very common, especially in Bengal and in Southern India, and often creeps into the houses."

Distinguishing Features.—Kraits can be distinguished from all other local snakes by the fact that on the ventral surface posterior to the vent there is a *single* row of scales, whereas in all other local species there are two or more rows of scales. Few would care to pick up a living krait in order to turn it over and inspect its scales, but if the snake is dead it is a matter of a moment to check whether or not it may be a krait. Both local species possess a well-developed dorsal ridge, but this is not a feature unique to kraits.

Bungarus fasciatus (*Banded Krait*).

The Banded Krait—gold leg-band. Alternate black or blue-black and yellow bands (about thirty of each) *completely* encircling the body from behind head to tip of tail. The bands vary in width with the age of the specimen, perhaps being as much as two inches in width in a full-grown snake. The black and yellow bands are of nearly *equal width,* though the black may possibly be twice the width of the yellow bands. *Length,* up to five or six feet. *Distribution,* sea-level to the top of the Peak. *Habits,* nocturnal, day-blind and never strikes during the daytime, sluggish and docile; enters houses occasionally in search of rats and mice.

Bungarus candidus (*Common Indian Krait*).

Two varieties (var. *B. cæruleus* and var. *B. multicinctus*). Colloquially—silver leg-band. Alternate dark brown or blackish bars and yellowish-white or white bands. The dark bars *do not completely* circle the body but round off at the beginning of the ventral scales, i.e., ventral surface is uniformly yellowish-white. The type comes from Java: *B. c. cæruleus* from India and *B. c. multicinctus* from China, though there is no hard and fast rule with either variety. In the local variety there are usually between forty-five and fifty-five bands of each colour, the dark bars being *two or three times* the width of the pale bands. *Length,* rarely reaches three feet. *Distribution and habits,* similar to the banded krait, though much less common.

Vipers.

The Chinese variety is represented by the Crotalinæ, or pit-vipers, so-called from a pit in the loreal region. The arrow-shaped head is an easily recognized characteristic of the species. They have well-developed poison glands and their bite has been attended in many cases by fatal results, but this is less the case with local species than with such forms as the rattle-snake, and the related true viper of India (*Vipera russelli*).

Trimeresurus gramineus (*Bamboo-snake*).

Light, or bright, green upper surface, white or yellowish underneath. Well-marked "pit" in loreal region of head, i.e., between and extending behind the eyes. Head arrow-shaped, narrowing sharply to the neck. *Length,*

from two to two-and-half feet. *Distribution*, from sea-level to the Peak. *Habits*, active during morning and evening, and found, as the name implies, in bamboo or dense undergrowth.

HYDROPHIINÆ.

Two varieties are found in Chinese waters, *Hydrophis cyanocincta*—banded sea-snake—and *Hydrophis multimaculata*—spotted sea-snake. Sea-snakes are easily recognizable by their flat tail which is used in swimming; they are without exception venomous and, judging from such cases as have been put on record and by recent laboratory work on their venom, it seems probable that they are more deadly than the Elapinæ. They are, however, of a sluggish disposition and bite only under great provocation. Not common near Hong Kong, only a few specimens having been captured. One was taken by troops at Laichikok bathing beach, being stoned to death. Usually black-and-white, or black-and-grey, with numerous rings or markings along whole length of body.

PTYADÆ.

Two types of rat-snakes, non-venomous, but fierce when aroused and will strike when provoked. Their size, from four to eight feet, makes them appear formidable. *Ptyas mucosus*, the large rat-snake, may often be seen swimming in irrigation ditches and swamps. *Ptyas korros* may be found in undergrowth near to roads and houses in country districts.

VENOM AND SYMPTOMS OF SNAKE-BITE.

In 1923, Dr. Malcolm Smith wrote the following in the *Journal of the Natural History Society of Siam*: "The amount of venom which a snake can inject at one bite varies according to circumstances. If the snake has not bitten anything for several days the glands are fully charged. It has been estimated that an adult cobra, with its glands full, can inject at one bite enough poison to kill ten ordinary people. It follows that, if it is called upon to bite a second time before the glands can be re-charged, the dose of venom given will be less, and so on with each successive bite. In illustration of this, there is the remarkable story recorded by Sir Joseph Fayrer, of four men who allowed themselves to be bitten by an Indian krait (*B. candidus*) in the belief that it would do them no harm. They were bitten at night and the snake was goaded on to bite by being hit with a stick. The man who was first bitten died before the night was out, the second and third died in the course of the next morning, whilst the last man to be bitten, after being seriously ill, recovered.

Venom fangs are generally to be found lying in a fold of skin when not in use, becoming vertical or nearly so when they are required to bite. Inside each fang is a gradually decreasing series of auxiliaries, which are ready to take the place of the old fang when it is discarded. This applies to the teeth of snakes in general, so that it is never safe to regard a snake as harmless because the fangs have been drawn; they are quickly replaced.

Many curious changes take place in individual snakes of the same species living in different surroundings, and the study of equatorial fauna on these lines is of great interest. It is difficult, therefore, to estimate the toxicity of the snakes of South China without data. Upon this question largely depends the nature of the remedy to be used; for whereas in Malaya the bite of the common cobra has frequently been successfully treated by means readily available in any hospital, in India only the prompt use of a specially prepared anti-venene has been of avail in saving life. Before going fully into the question of symptoms of snake-bite, a word on the nature and effects of venom may be necessary.

Snake-venom is built up in the same way as all body substances; it is not of the order of a poisonous drug for which a remedy may easily be found. It consists of proteins in solution, of two main types, affecting the blood-system and the nerves respectively, and the character of the symptoms produced depends on the proportions in which they are present. Venom is stored in a modified salivary gland, and passes along a duct to the fang, which in the Colubridæ is grooved anteriorly. In vipers, the groove is closed over, leaving a hollow channel acting as an effective instrument for the injection of the venom.

The two types of poisoning generally recognized by medical authorities are :—

(1) *Colubrine.*—Affects the nervous system and paralyses that portion of the medulla which controls respiration: should death supervene it is caused by asphyxia. A ferment in the venom which reduces the clotting power of the blood may cause a certain amount of initial hæmorrhage, but this is frequently counteracted by another ferment which produces constriction of the blood-vessels.

The symptoms of cobra poisoning, taken as an example of the Colubrine group, are :—

(i) A feeling of weakness, accompanied usually by severe and persistent pain.
(ii) A gradual paralysis progressing upwards from the legs to the head.
(iii) Relaxation of the lower lip and emission of saliva.
(iv) Gradual loss of the power of speech.
(v) Asphyxiation.

Burning pain and local swelling after the bite are often present. Nausea is a frequent complication. The patient may retain consciousness throughout, and must not be allowed to become depressed and give up the struggle. It may be necessary to administer artificial respiration.

Syncope is a frequent complication of snake-bite. It is often induced to a great extent by apprehension, but the activity of the venom plays its part. The vasomotor nerves become paralysed, resulting in dilatation of the blood-vessels, more especially in the region of the abdomen. These take up all the blood, leaving a shortage for the brain, heart and respiratory centres.

(2) *Viperine.*—Destroys the lining of the blood-vessels and breaks down the corpuscles; it also attacks the vasomotor centre, which controls the reactions of the blood-vessels. In their damaged state the walls of the blood-vessels become more than ordinarily permeable. Just as, normally, food substance passes from the gut into the vessels, so now transudation of blood occurs in an opposite direction, leading to internal hæmorrhage. Blood may escape from the wound and also from mucous surfaces. Septicæmia, which is a quite definite form of blood-poisoning due to the presence of germs, may set in. Syncope is to be expected."

Travel.

BEYOND LEH.

A SHOOTING TRIP IN LADAKH, 1926.

Being a Diary kept by

K. W. DICKSON, F.R.G.S.

(*Continued from p.* 393.)

XVI.—Kaisser.

We started for Kaisser on a perfect morning. It was quite hot marching, a cloudless sky, and the river as blue as the sky, with greens and blues glinting in it. It was hardly credible that we had experienced such frost only one day before. We were feeling a little cheap after the strain of those days up the Chumatang Poo, so I rode most of the way, and R. did not hurry. Nothing would induce me to go again to such an altitude at such a season without sleeping bags, and I would have a canvas floor to our tent, all made in one piece with the walls.

I waited behind to watch some women weaving cloth on the outskirts of Chumatang. Instead of using a shuttle, they had the strands of wool far enough apart to throw a ball of wool left to right hand, and right to left. The material is seldom more than twelve inches wide, so they had not far to throw.

I saw a tiny little stone marten among the rocks. It looked very soft and fluffy, and was a soft grey colour.

R. shot a duck not far from Kilmung, and it floated downstream in smooth water. The Kashmiri boy was there and walked along the edge watching it, but did not attempt to go into the water to retrieve it, much to R.'s annoyance, and the duck was lost. R. asked him what kind of a shikari he was going to be when he was afraid of getting his feet wet.

The river takes a bend round Kilmung, so that looking down, the village lies in the middle of the valley. It would have made a very pretty sketch, all the colours were so clear and pure, the sky and the water, and those

rust-coloured hills. The next trek we go on, I am to be allowed to stop and sketch for a day when we come to a picturesque spot. I am to have a day's sketching to R.'s one day's stalking.

I had a very slow pony and R. had gone about two miles ahead, but I caught up to him beyond Kilmung where we changed transport. Three tiny little foals had followed their baggage-laden mothers as far as this. Eight fine yaks were waiting for us, and another pony for me—a faster one I was glad to find. Some chikor flew up from the rocks beside the path, and R. shot one. The river is much bigger than it was ten days before; now that the weather is warmer, the higher snows that feed the Indus were beginning to melt. The fields were not ploughed here yet.

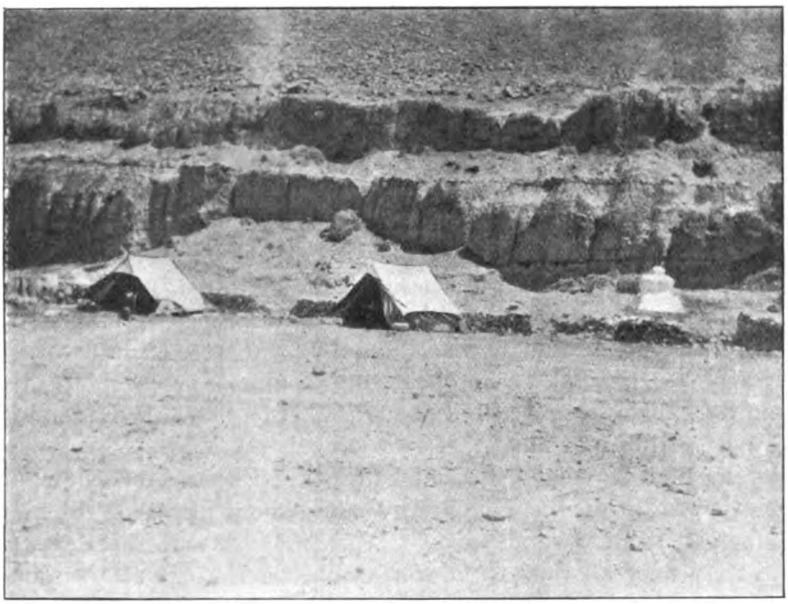

FIG. 18.—Camp below the cliffs at Kaisser showing white chorten.

A high hill stood straight up on the south side of the river, and mud cliffs surmounted by steep shale slopes rose sheer up behind us, so the sun did not reach us until late in the morning.

There was no milk to be had in the tiny village of Kaisser, which consisted of six or eight scattered mud huts. They sent a man off with a brass jug to a village six miles away to get milk. When it arrived it was full of sand, and had to be strained through fourfold muslin before being boiled. It was only goats' milk, but we were very glad to get it. Sooner or later sand gets into everything in Ladakh; it was in our beds, our clothes, our hair, and the store yakdans were full of it. I found that dressing my hair like a little German maidservant was the best way to keep it from the dust. I wound the pigtails round my head, leaving nothing loose to collect sand.

R. went off about 6 o'clock next morning. I watched the party climb a path in the cliffs, and then across a steep incline to the Yeh Poo, a narrow nullah which wound up to the higher hills. Here they hoped to find more burrhel. R's licence allowed him four heads; so far he had two, so there was always the hope of getting a still larger head. I sat down to the diary and got it up to date.

When the sun was warm enough the bedding was all shaken and hung out, and we got some washing done. We had not had a halt since the days up the Chumatang Poo, and there as little as possible was done, as our one concern was to keep warm. R. says my passion for cleanliness is very disturbing on the march, but if it was not for this so-called passion, he would be complaining of the dirt.

Clouds had come up, and it was very cold. R. had the watch, so I did not know the time. Tea did not come when I expected it, so I started off up the hill to meet R., the dogs very pleased to have a run again. I got a lovely view; there was a fine light on the hills, the level rays of the sun lighting up the furthest peaks. I went right up the cliff path and across the steep incline to the foot of the narrow gorge, but saw no sign of the shooting party. I began to feel empty, and remembered I had had nothing since about 11.30. I walked slowly down the path, the dogs going off on different scents, but keeping fairly near. I crossed the little fields to our camp and when I looked round I saw five men far above me, climbing down the path I had just left. I had missed them by a quarter of an hour. They arrived in camp very tired, having been out for almost twelve hours, trekked sixteen miles, and crossed a hill of about 19,000 feet. They had seen small burrhel, but no head of any size.

Tea was so late we decided to miss dinner and have only a bowl of soup before we turned into bed. Khazir But came about plans for the morning, and R. suggested that I should go with them next day up the Kaisser-i-Poo nullah. They were all very tired, so I would be the excuse for not going too far.

Thursday, May 21, Kaisser: "The end of a perfect shikar day; a fine head is just being brought into camp," was the first entry in my diary.

We left just after 6.30, a fine crisp morning, at first following the path down the Indus, and then turning up north by the tiny Kaisser-i-Poo River. There were about three miles of very rough going over boulders and slate rocks, then we came to a little gorge where the river went through a tunnel, and we climbed up a stairway in the rocks 100 feet high. There was an opening between the rocks at the top, and as we came up the shikari and the local guide signed to us to come quietly, so we knew some game was in sight. We peered through the opening and saw a young burrhel and a ewe feeding on the hill opposite, and climbing as they fed. They were well within rifle range, only a steep gorge between us. We lay quiet for some time to see if a herd would appear. It seemed too good luck to see any when we had only been out for two hours. I was afraid I would sneeze

with the sun tickling my eyes, and any little sound would frighten the burrhel.

No more appeared, and we crept down the path on the other side, following the stream to the right for another three or four miles. Again it was very stiff going, over boulders and uphill to boot. About 1 o'clock we got behind some rocks in a side nullah, and drank our coffee and ate the biscuits and cheese we had brought in our pockets. The tiffin basket was left behind that day, as the coolies had enough to carry if we got a burrhel. The shikari and the other three men went ahead a little and scanned the hillside. We looked round in every direction too, but nothing was to be seen, not a sign of life; an occasional kite flying across made the only movement in the whole landscape. Then we noticed the shikari had the telescope out, and soon they signed to R. to go and look.

A herd had been spotted on the opposite hillside, hardly visible to the naked eye, but very distinct through the telescope. After a short discussion about which would be the best route to take, R. and the shikari and the local man dropped down to the stream, and climbed up where a natural wall of stone hid them from the part of the hillside where the burrhel were feeding. I watched through the telescope. The herd was feeding, but slowly moving uphill as they fed, further and further away from the place where R. had got to. I could count nine, but probably there were more; there were three rams with fine heads. It was very interesting seeing them so clearly, one scratching its head with a hind foot, and two boxing like a pair of billy-goats. I specially noticed one with very dark marking, quite black on the chest and down the front of its legs; this one had the largest horns.

By the time R. reached the "wall" they were out of range, and fresh plans of attack had to be made; a wide detour, coming down almost to the stream before they could climb up behind another ridge of rock. By this time the herd had got wind of their whereabouts and were going fairly fast uphill. Through the telescope I saw the two shikaris and R. cross a very steep shale bank, then a high ridge of rock. At that moment the tiffin coolies asked for the telescope. I heard a shot, but could see nothing. A few minutes later I saw all three sitting amongst the rocks; R. was getting a new grass shoe put on, as he had lost one during the climb. I continued to watch intently through the telescope after that, and saw one man at a time climbing up. Then I heard another shot, but I did not see the herd again. They were probably climbing to the top of the hill by a hollow out of sight from where I was sitting. It seemed only a few minutes later when there were shouts to the tiffin coolies, and both dropped down to the stream and climbed up the other side. I could only imagine the shots were successful, and the tiffin coolies were wanted probably to bring the burrhel down. Soon afterwards, still through the telescope, I saw R. coming down the hill with Chota Subhana, the latter carrying the rifle and the other the telescope. I soon heard all about it. He had got the black-breasted one which looked the best in the herd.

I had meantime moved into a circle of rocks for shelter, as the wind was bitterly cold, and there had been a shower of snow. While we drank the rest of the coffee, I got the details of the stalk, then we started off for home. It was early in the day, only 1.30. We had sighted the herd at 10 o'clock, and the shots were fired about 12.30.

It was a good tramp back to Kaisser by the same rocky road. We had several drinks from the stream, and we stopped for one short rest at the top of the gorge, when a little stone marten came out and looked at us, only a few yards away.

We got back to camp about 3.30. Chota Subhana had gone on ahead to send two village men up to help to bring down the burrhel, and we met the men on the path by the Indus. Tea was ready and we were glad the teapot was a big one. There was no milk, but we found two drops of lemon essence in each cup very refreshing.

We decided on a rest next day; partly to get our mail ready before sending the coolie to Leh for letters. The weather was delightful; just a touch of frost in the early mornings. After giving out stores and seeing some washing done, we got under the shelter of a stone dyke, and got on with our mail.

I had what I felt to be a well-earned rest after tiffin, and R. slept outside. Khansamah came and told me he had a very special dinner for us; as he had now plenty of meat, he gave us a delicious clear soup. It was indeed a treat, and with stewed hare made an excellent dinner.

(*To be continued.*)

Current Literature.

AYKROYD, W. R. **Diet in Relation to Small Incomes.** *Quarterly Bull. Health Organization, League of Nations.* Geneva, 1933, v. 2, 130-53. [Refs. in footnotes.]

It is estimated that the diet of an unemployed man should provide about 2,500 calories. In order to construct a low cost adequate diet the minimal requirements of the essential foodstuffs must be provided; protein should have a minimum value of 70 grammes daily, of which 35 grammes is of animal origin, and a minimum of 56 grammes of fat is required. The vitamins must also be supplied, but the exact amounts required are still unknown. Of the minerals, calcium, phosphorus, iron and iodine are of chief importance, and the fact that children and pregnant women require larger amounts of calcium than the adult must be allowed for. A low cost adequate diet has been constructed based on English dietary habits and calculated at 1932-33 prices which provides daily 2,505 calories at an estimated cost of 5s. 9d. weekly. This diet is moderately satisfactory as regards quality, providing 81 grammes of protein (36 grammes animal) and

88 grammes of fat, whilst other food factors are present in fairly adequate amounts. It contains 5 pints of milk weekly, which is somewhat larger than is found in the average working class diet. On the basis of present unemployment allowances, the percentage of the allowance that would be spent on this diet varies from 36 in the case of a single man to 63 in the case of a man, wife and 3 children. Other low cost diets have been constructed in Germany, and are essentially similar except in the variety of foods provided. The question of improving the diet of the very poor, unemployed or otherwise, depends in the first place on the relation of the income to the cheapest adequate diet. In Germany the unemployment benefit is often not sufficient to provide this low cost adequate diet, and the person must live on a reduced diet largely made up of the cheapest foods, such as bread, potatoes and margarine. It has been shown that in poor families the type of diet provided is very dependent on "maternal efficiency," and therefore education of the mothers should be capable of bringing about improvement in the diet. Much tact and skill had to be used in propaganda of this kind when directed to a population struggling on an inadequate income.

[Much statistical information regarding the diets of German, English and American working class families has been collected from various sources and in the summarized form, as presented in this article, should be useful to public health authorities.] H. N. H. GREEN.

Reprinted from "Bulletin of Hygiene," Vol. 8, *No.* 8.

AMERICAN PUBLIC HEALTH ASSOCIATION YEAR BOOK, 1932-1933. (*Supp. Amer. J. Pub. Health.* 1933, v. 23, June, 126—33). **Taste and Odour Removal Processes.** [Report of Committee on Water Supply, J. R. BAYLISS, Chairman.]

The methods of taste and odour removal considered in this report are the ammonia-chlorine, activated carbon, aeration, high chlorination, ozone and potassium permanganate treatments. The use of ammonia-chlorine is becoming very extensive for it has the advantages that it eliminates chlorine and chlorophenol tastes, it retards or prevents after-growths, reduces the amount of chlorine necessary to sterilize the water, is possibly more effective than chlorine alone as a bactericide and allows a high residual chlorine to be maintained. The introduction of the method has resulted in much greater purity of the water as judged by the bacterial analysis. Treatment is usually applied after filtration, the ammonia being first added in the form either of ammonium sulphate, ammonia solution, or of anhydrous ammonia which is supplied in the liquid form in steel cylinders. This ammonia-chlorine process is chiefly of value in the prevention of chlorine and chlorophenol tastes. Activated carbon is also being extensively used for the removal of all kinds of tastes and odours. The powdered carbon is added to and mixed with the water which may then be allowed to sediment before filtration. In a few places water is filtered through beds

of granular activated carbon. Carbon is extremely effective in removing algal tastes and is used chiefly to remove tastes of that type. It also removes chlorophenol tastes and chlorine, but for the latter purpose a high dosage is required. Aeration is used effectively for the removal of certain tastes but it is not successful with all of them.

Superchlorination followed by dechlorination with sodium bisulphite has been adopted with success by some plants during periods when there is considerable pollution or when the natural taste or odour of the water is very pronounced. The use of ozone although a more costly process is being extended gradually for, in addition to being effectively bactericidal, it will also remove many of the tastes and odours of water. It is, however, a treatment which should probably be used only in conjunction with chlorine or chloramine. Potassium permanganate is still used as an effective remover of certain tastes and odours but it is doubtful if it is cheaper than some of the other methods of elimination. It is important in considering all the available methods of treatment to understand that each taste and odour condition is an individual problem requiring careful study to determine the best and most economical method of treatment.

M. E. Delafield.

Reprinted from "Bulletin of Hygiene," Vol. 8, No. 9.

Graf, A. V. **When and How to Wash a Filter.** *Water Works Eng.* 1932, v. 85, 1516. [Summary taken from *Dept. Scient. and Indust. Res. Water Pollution Research. Summary of Current Literature.* 1933, v. 6, 189].

Methods of determining when a filter should be washed vary. Some are washed at fixed periods, others at a certain loss of head, sometimes regardless of and sometimes with a limit set to the length of run, and others when the effluent shows a certain turbidity. The loss of head at which a filter should be washed is that at which the smallest percentage of wash water is necessary, showing that the filter is not caked and suspended matter has not penetrated into the deeper sand. Instructions are given for procedure in washing a filter. The sand expansion should be as great as possible without washing sand into the overflows. A 50 per cent. rise will generally prevent excessive sand settlement but it is not possible with all filters. The effect of temperature on sand expansion is pointed out.

Reprinted from "Bulletin of Hygiene," Vol. 8, No. 9.

Reviews.

CLINICAL OPHTHALMOLOGY FOR HOUSE SURGEONS AND STUDENTS. By J. Giles Bickerton, M.A., B.Ch.(Cantab), F.R.C.S., and L. H. Savin, M.D., M.R.C.P., F.R.C.S. London: H. K. Lewis and Co. 1933. Pp. vii + 158. Price 7s. 6d. net.

This book on Clinical Ophthalmology is written for house surgeons and students.

The authors rightly say in the preface that the student is appalled by the bulk of most ophthalmological textbooks. The scope of this work has been dictated by a study of examination papers of the last twenty years.

The book is well printed but as it consists of only 158 pages the subject matter is condensed and dogmatic in style.

The short accounts of many operations would be of value in answering examination questions, but would serve only as an introduction to the inexperienced operator.

The authors can have no experience of the intracapsular method of cataract extraction, as they are quite wrong in stating that the patient is made to look up towards his hair during the operation.

Chapter I describes the methods of case examination, firstly without instruments, and secondly with instruments; it is clearly and simply written. The common conditions affecting the different parts of the eye are dealt with in succeeding chapters, and definite methods of treatment are laid down.

There is a chapter on sight testing for beginners, and a valuable chapter on ophthalmoscopic appearances in disease, with very good plates illustrating these appearances.

Selected ophthalmic formulæ are given at the end, and there is an illustrated appendix of instruments required for various operations.

R.A.M.C. officers who require a small book on eyes easy of reference would do well to purchase this work.

SYNOPSIS OF SURGERY. By E. W. Hey Groves, M.S., M.D., B.Sc., F.R.C.S. Bristol: John Wright and Sons, Ltd. 1933. Pp. viii + 693. Price 17s. 6d. net.

This is the tenth edition of this synopsis, and the fact that since 1908, when the first edition appeared, constant new editions have been required shows the necessity and popularity of a book such as this.

The scope of the book is well described in the preface to the first edition in which the author states: "The present volume is an attempt to make an epitome of the salient facts in surgical practice, and to place these facts in such a manner that they may most easily and rapidly be referred to or revised."

In this latest edition the sections on the radium treatment of malignant

disease, the surgery of the sympathetic nervous system, and the vaseline pack method (Winnett-Orr) of treating septic bone conditions, have been re-written.

A new chapter giving in brief outline the principles of amputations has been added.

A perusal of the book shows that the author has succeeded in his endeavour to present the salient facts of surgical practice clearly and shortly. But he has done more than this, for he has produced a book which can be read with interest. Compression has not been carried to the point of reducing the subject matter to a series of lists of signs, symptoms and diagnostic points. In some sections, such as the tests for renal insufficiency, the methods to be adopted are far more clearly set out than in many of the systematic treatises on surgery.

There are 164 illustrations, all of which are carefully chosen to illustrate the text.

Thirteen very useful plates illustrate the chapter on surface markings.

We note that in describing the selection of a donor for blood transfusion no mention is made of a direct test between the patient's serum and the prospective donor's corpuscles, which should be regarded as an essential even if a Group 4 donor is available.

The book is very well printed and produced and free from printers' errors.

It is an excellent addition to the library of any medical man for ready reference and will be of the greatest assistance to a student reading for his final examination or even to a graduate preparing for a higher qualification.

Both author and publishers are to be congratulated on the production of this valuable little book.

J. W. W.

THE ANATOMY OF THE EYE AND ORBIT. By Eugene Wolff, M.B., B.S.Lond., F.R.C.S.Eng. London: H. K. Lewis and Co., Ltd. 1933. Pp. viii + 310. 173 illustrations. Price 31s. 6d. net.

This book, as stated by the author in a short preface, is "an attempt to present to the student and ophthalmic surgeon the essentials of the structure, development and comparative anatomy of the visual apparatus in conjunction with some of their clinical applications." This object has been obtained with signal success.

The anatomical relations of the orbit and paranasal sinuses are clearly described, and there is a very complete survey of the eyeball in regard both to the structure and function of its different parts.

In chapters III, V and VII the author describes respectively, the appendages, the extrinsic muscles, and the blood-vessels of the eye. The fourth chapter contains a short account of the slit-lamp appearances of the normal eye.

The sixth chapter presents an admirable account of the cranial nerves

subserving the eye, including the optic nerve and its central connections, the path of the light reflex and the involuntary nervous system.

The development of the eye, and the comparative anatomy of the organ are dealt with in the last two chapters.

While all the illustrations attain a high standard, those drawn by Mr. A. K. Maxwell from the author's dissections of the orbit are outstanding.

Throughout the book brief clinical notes in italics are given where appropriate, and each chapter is concluded by a bibliography.

Notices.

"WELLCOME" BRAND ANTI-PNEUMOCOCCUS SERA.

APPROXIMATELY half of all cases of lobar pneumonia in various parts of the world are caused by pneumococcus Type I or II. Therefore many physicians wish to give mixed I + II serum immediately the patient is seen. For this purpose "Wellcome" Brand Concentrated Anti-Pneumococcus Serum, Type I + II, is available. Each phial of the mixed concentrated serum contains 10,000 units of each antitoxin.

The type of the infecting cause is ascertained, and if it belongs to Type I or II, the appropriate serum is used for treatment. Both Concentrated and Unconcentrated Anti-Pneumococcus Sera of each type are issued. "Wellcome" Brand Sera are prepared at The Wellcome Physiological Research Laboratories, Beckenham, Kent, and supplied by Burroughs Wellcome and Co.

A system of Telegraphic Code Words which simplifies the ordering of these products and ensures correctness may be found in Wellcome's Medical Diary or Burroughs Wellcome and Co.'s Trade Price List.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (UNIVERSITY OF LONDON).

THE next series of Lectures and Demonstrations on Tropical Hygiene, which are intended for men and women outside the medical profession proceeding to the Tropics, will be given by Lieutenant-Colonel G. E. F. Stammers, O.B.E., M.R.C.S., L.R.C.P., D.P.H., from December 4 to 13, 1933. The course comprises eight lectures, which will be given from 5 to 6.30 p.m. on each day.

These courses of instruction, in addition to providing simple rules for guidance in regard to personal hygiene and preparation for life in the Tropics, will also embrace a short account of some of the more common diseases, with advice in regard to measures of protection and self-treatment.

The synopsis and other particulars can be obtained from the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.

INDEX TO VOLUME LXI.

C.N. = Clinical and other Notes.
C.L. = Current Literature.

possible identification. The reason for this is that the nature of the venom, and consequently of the antidote, varies even between one species and another.

It is a common error to believe that snakes lie in wait, ready and eager to snap at the heels of passing man. Nothing is further from the truth ; like most animals they usually only attack man when provoked or suddenly disturbed, then fear drives them to their only method of defence. If they see a way of escape from a potential enemy they will take it.

ELAPINÆ.

Cobras.

Cobras in Hong Kong and the New Territories are found usually in the spring and early summer months. They are readily recognizable by the hood and its spectacle, which distends when the snake is aroused, and by the hiss with which venom is ejected, and even before ejection of poison.

Distinguishing Features.—Easily distinguishable on account of the hood posterior to the head which distends when the first segments are raised erect for striking to perhaps three or four times the diameter of the rest of the body and relaxes when the head is lowered. The Chinese colloquial name, rice-spoon head, is aptly descriptive of the head which is like the inverted bowl of a spoon.

Naja Naja Atra (*Cobra.*)

The " spectacle " is easily visible when the hood is distended. The head and neck are white or yellow underneath. At intervals of from one-half to one inch along the body are narrow bands of white or yellow, the general colouring of the body being blackish or dark-brownish. *Length*, up to three or three-and-a-half feet. *Distribution*, from sea-level to the top of the Peak. *Habits*, most active evening and morning, sleepy during the day. Young cobras occasionally enter houses though adults rarely do so. Young ones carry a considerable amount of venom, but the bite is not so likely to be fatal as that of adults. Generally the venom is less powerful than that of the Indian cobra.

Kraits.

Of the four local groups of banded snakes the kraits are most to be feared on account of the virulence of their venom and on account of their relative abundance. Fortunately, however, kraits are nocturnal snakes and only under very exceptional circumstances can they be induced to bite during the day-time. Mell, in 1928, said, " Nocturnal animals with round pupils, almost or entirely incapable of being narrowed, like *Bungarus calliophis*, seem to be temporarily blind during the day. As a result no one has ever succeeded in making a sexually mature Bungarus bite during the day, even though it is a close relative of the cobra. It possesses a very effective poison."

Gadow, in the " Cambridge Natural History," writes : " The krait

seems to cause more deaths in India than any other snake since it is very common, especially in Bengal and in Southern India, and often creeps into the houses."

Distinguishing Features.—Kraits can be distinguished from all other local snakes by the fact that on the ventral surface posterior to the vent there is a *single* row of scales, whereas in all other local species there are two or more rows of scales. Few would care to pick up a living krait in order to turn it over and inspect its scales, but if the snake is dead it is a matter of a moment to check whether or not it may be a krait. Both local species possess a well-developed dorsal ridge, but this is not a feature unique to kraits.

Bungarus fasciatus (*Banded Krait*).

The Banded Krait—gold leg-band. Alternate black or blue-black and yellow bands (about thirty of each) *completely* encircling the body from behind head to tip of tail. The bands vary in width with the age of the specimen, perhaps being as much as two inches in width in a full-grown snake. The black and yellow bands are of nearly *equal width*, though the black may possibly be twice the width of the yellow bands. *Length*, up to five or six feet. *Distribution*, sea-level to the top of the Peak. *Habits*, nocturnal, day-blind and never strikes during the daytime, sluggish and docile; enters houses occasionally in search of rats and mice.

Bungarus candidus (*Common Indian Krait*).

Two varieties (var. *B. cæruleus* and var. *B. multicinctus*). Colloquially—silver leg-band. Alternate dark brown or blackish bars and yellowish-white or white bands. The dark bars *do not completely* circle the body but round off at the beginning of the ventral scales, i.e., ventral surface is uniformly yellowish-white. The type comes from Java: *B. c. cæruleus* from India and *B. c. multicinctus* from China, though there is no hard and fast rule with either variety. In the local variety there are usually between forty-five and fifty-five bands of each colour, the dark bars being *two or three times* the width of the pale bands. *Length*, rarely reaches three feet. *Distribution and habits*, similar to the banded krait, though much less common.

Vipers.

The Chinese variety is represented by the Crotalinæ, or pit-vipers, so-called from a pit in the loreal region. The arrow-shaped head is an easily recognized characteristic of the species. They have well-developed poison glands and their bite has been attended in many cases by fatal results, but this is less the case with local species than with such forms as the rattlesnake, and the related true viper of India (*Vipera russelli*).

Trimere surus gramineus (*Bamboo-snake*).

Light, or bright, green upper surface, white or yellowish underneath. Well-marked "pit" in loreal region of head, i.e., between and extending behind the eyes. Head arrow-shaped, narrowing sharply to the neck. *Length*,

from two to two-and-half feet. *Distribution*, from sea-level to the Peak. *Habits*, active during morning and evening, and found, as the name implies, in bamboo or dense undergrowth.

HYDROPHIINÆ.

Two varieties are found in Chinese waters, *Hydrophis cyanocincta*—banded sea-snake—and *Hydrophis multimaculata*—spotted sea-snake. Sea-snakes are easily recognizable by their flat tail which is used in swimming; they are without exception venomous and, judging from such cases as have been put on record and by recent laboratory work on their venom, it seems probable that they are more deadly than the Elapinæ. They are, however, of a sluggish disposition and bite only under great provocation. Not common near Hong Kong, only a few specimens having been captured. One was taken by troops at Laichikok bathing beach, being stoned to death. Usually black-and-white, or black-and-grey, with numerous rings or markings along whole length of body.

PTYADÆ.

Two types of rat-snakes, non-venomous, but fierce when aroused and will strike when provoked. Their size, from four to eight feet, makes them appear formidable. *Ptyas mucosus*, the large rat-snake, may often be seen swimming in irrigation ditches and swamps. *Ptyas korros* may be found in undergrowth near to roads and houses in country districts.

VENOM AND SYMPTOMS OF SNAKE-BITE.

In 1923, Dr. Malcolm Smith wrote the following in the *Journal of the Natural History Society of Siam*: "The amount of venom which a snake can inject at one bite varies according to circumstances. If the snake has not bitten anything for several days the glands are fully charged. It has been estimated that an adult cobra, with its glands full, can inject at one bite enough poison to kill ten ordinary people. It follows that, if it is called upon to bite a second time before the glands can be re-charged, the dose of venom given will be less, and so on with each successive bite. In illustration of this, there is the remarkable story recorded by Sir Joseph Fayrer, of four men who allowed themselves to be bitten by an Indian krait (*B. candidus*) in the belief that it would do them no harm. They were bitten at night and the snake was goaded on to bite by being hit with a stick. The man who was first bitten died before the night was out, the second and third died in the course of the next morning, whilst the last man to be bitten, after being seriously ill, recovered.

Venom fangs are generally to be found lying in a fold of skin when not in use, becoming vertical or nearly so when they are required to bite. Inside each fang is a gradually decreasing series of auxiliaries, which are ready to take the place of the old fang when it is discarded. This applies to the teeth of snakes in general, so that it is never safe to regard a snake as harmless because the fangs have been drawn; they are quickly replaced.

Many curious changes take place in individual snakes of the same species living in different surroundings, and the study of equatorial fauna on these lines is of great interest. It is difficult, therefore, to estimate the toxicity of the snakes of South China without data. Upon this question largely depends the nature of the remedy to be used; for whereas in Malaya the bite of the common cobra has frequently been successfully treated by means readily available in any hospital, in India only the prompt use of a specially prepared anti-venene has been of avail in saving life. Before going fully into the question of symptoms of snake-bite, a word on the nature and effects of venom may be necessary.

Snake-venom is built up in the same way as all body substances; it is not of the order of a poisonous drug for which a remedy may easily be found. It consists of proteins in solution, of two main types, affecting the blood-system and the nerves respectively, and the character of the symptoms produced depends on the proportions in which they are present. Venom is stored in a modified salivary gland, and passes along a duct to the fang, which in the Colubridæ is grooved anteriorly. In vipers, the groove is closed over, leaving a hollow channel acting as an effective instrument for the injection of the venom.

The two types of poisoning generally recognized by medical authorities are:—

(1) *Colubrine.*—Affects the nervous system and paralyses that portion of the medulla which controls respiration: should death supervene it is caused by asphyxia. A ferment in the venom which reduces the clotting power of the blood may cause a certain amount of initial hæmorrhage, but this is frequently counteracted by another ferment which produces constriction of the blood-vessels.

The symptoms of cobra poisoning, taken as an example of the Colubrine group, are:—

(i) A feeling of weakness, accompanied usually by severe and persistent pain.
(ii) A gradual paralysis progressing upwards from the legs to the head.
(iii) Relaxation of the lower lip and emission of saliva.
(iv) Gradual loss of the power of speech.
(v) Asphyxiation.

Burning pain and local swelling after the bite are often present. Nausea is a frequent complication. The patient may retain consciousness throughout, and must not be allowed to become depressed and give up the struggle. It may be necessary to administer artificial respiration.

Syncope is a frequent complication of snake-bite. It is often induced to a great extent by apprehension, but the activity of the venom plays its part. The vasomotor nerves become paralysed, resulting in dilatation of the blood-vessels, more especially in the region of the abdomen. These take up all the blood, leaving a shortage for the brain, heart and respiratory centres.

(2) *Viperine.*—Destroys the lining of the blood-vessels and breaks down the corpuscles; it also attacks the vasomotor centre, which controls the reactions of the blood-vessels. In their damaged state the walls of the blood-vessels become more than ordinarily permeable. Just as, normally, food substance passes from the gut into the vessels, so now transudation of blood occurs in an opposite direction, leading to internal hæmorrhage. Blood may escape from the wound and also from mucous surfaces. Septicæmia, which is a quite definite form of blood-poisoning due to the presence of germs, may set in. Syncope is to be expected."

Travel.

BEYOND LEH.

A SHOOTING TRIP IN LADAKH, 1926.

Being a Diary kept by

K. W. DICKSON, F.R.G.S.

(*Continued from* p. 393.)

XVI.—Kaisser.

We started for Kaisser on a perfect morning. It was quite hot marching, a cloudless sky, and the river as blue as the sky, with greens and blues glinting in it. It was hardly credible that we had experienced such frost only one day before. We were feeling a little cheap after the strain of those days up the Chumatang Poo, so I rode most of the way, and R. did not hurry. Nothing would induce me to go again to such an altitude at such a season without sleeping bags, and I would have a canvas floor to our tent, all made in one piece with the walls.

I waited behind to watch some women weaving cloth on the outskirts of Chumatang. Instead of using a shuttle, they had the strands of wool far enough apart to throw a ball of wool left to right hand, and right to left. The material is seldom more than twelve inches wide, so they had not far to throw.

I saw a tiny little stone marten among the rocks. It looked very soft and fluffy, and was a soft grey colour.

R. shot a duck not far from Kilmung, and it floated downstream in smooth water. The Kashmiri boy was there and walked along the edge watching it, but did not attempt to go into the water to retrieve it, much to R.'s annoyance, and the duck was lost. R. asked him what kind of a shikari he was going to be when he was afraid of getting his feet wet.

The river takes a bend round Kilmung, so that looking down, the village lies in the middle of the valley. It would have made a very pretty sketch, all the colours were so clear and pure, the sky and the water, and those

rust-coloured hills. The next trek we go on, I am to be allowed to stop and sketch for a day when we come to a picturesque spot. I am to have a day's sketching to R.'s one day's stalking.

I had a very slow pony and R. had gone about two miles ahead, but I caught up to him beyond Kilmung where we changed transport. Three tiny little foals had followed their baggage-laden mothers as far as this. Eight fine yaks were waiting for us, and another pony for me—a faster one I was glad to find. Some chikor flew up from the rocks beside the path, and R. shot one. The river is much bigger than it was ten days before; now that the weather is warmer, the higher snows that feed the Indus were beginning to melt. The fields were not ploughed here yet.

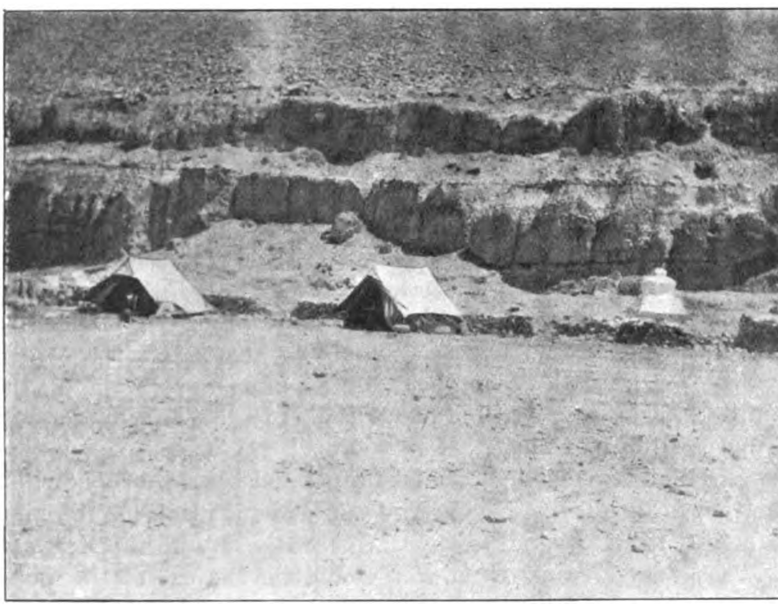

Fig. 18.—Camp below the cliffs at Kaisser showing white chorten.

A high hill stood straight up on the south side of the river, and mud cliffs surmounted by steep shale slopes rose sheer up behind us, so the sun did not reach us until late in the morning.

There was no milk to be had in the tiny village of Kaisser, which consisted of six or eight scattered mud huts. They sent a man off with a brass jug to a village six miles away to get milk. When it arrived it was full of sand, and had to be strained through fourfold muslin before being boiled. It was only goats' milk, but we were very glad to get it. Sooner or later sand gets into everything in Ladakh; it was in our beds, our clothes, our hair, and the store yakdans were full of it. I found that dressing my hair like a little German maidservant was the best way to keep it from the dust. I wound the pigtails round my head, leaving nothing loose to collect sand.

R. went off about 6 o'clock next morning. I watched the party climb a path in the cliffs, and then across a steep incline to the Yeh Poo, a narrow nullah which wound up to the higher hills. Here they hoped to find more burrhel. R's licence allowed him four heads; so far he had two, so there was always the hope of getting a still larger head. I sat down to the diary and got it up to date.

When the sun was warm enough the bedding was all shaken and hung out, and we got some washing done. We had not had a halt since the days up the Chumatang Poo, and there as little as possible was done, as our one concern was to keep warm. R. says my passion for cleanliness is very disturbing on the march, but if it was not for this so-called passion, he would be complaining of the dirt.

Clouds had come up, and it was very cold. R. had the watch, so I did not know the time. Tea did not come when I expected it, so I started off up the hill to meet R., the dogs very pleased to have a run again. I got a lovely view; there was a fine light on the hills, the level rays of the sun lighting up the furthest peaks. I went right up the cliff path and across the steep incline to the foot of the narrow gorge, but saw no sign of the shooting party. I began to feel empty, and remembered I had had nothing since about 11.30. I walked slowly down the path, the dogs going off on different scents, but keeping fairly near. I crossed the little fields to our camp and when I looked round I saw five men far above me, climbing down the path I had just left. I had missed them by a quarter of an hour. They arrived in camp very tired, having been out for almost twelve hours, trekked sixteen miles, and crossed a hill of about 19,000 feet. They had seen small burrhel, but no head of any size.

Tea was so late we decided to miss dinner and have only a bowl of soup before we turned into bed. Khazir But came about plans for the morning, and R. suggested that I should go with them next day up the Kaisser-i-Poo nullah. They were all very tired, so I would be the excuse for not going too far.

Thursday, May 21, Kaisser: "The end of a perfect shikar day; a fine head is just being brought into camp," was the first entry in my diary.

We left just after 6.30, a fine crisp morning, at first following the path down the Indus, and then turning up north by the tiny Kaisser-i-Poo River. There were about three miles of very rough going over boulders and slate rocks, then we came to a little gorge where the river went through a tunnel, and we climbed up a stairway in the rocks 100 feet high. There was an opening between the rocks at the top, and as we came up the shikari and the local guide signed to us to come quietly, so we knew some game was in sight. We peered through the opening and saw a young burrhel and a ewe feeding on the hill opposite, and climbing as they fed. They were well within rifle range, only a steep gorge between us. We lay quiet for some time to see if a herd would appear. It seemed too good luck to see any when we had only been out for two hours. I was afraid I would sneeze

with the sun tickling my eyes, and any little sound would frighten the burrhel.

No more appeared, and we crept down the path on the other side, following the stream to the right for another three or four miles. Again it was very stiff going, over boulders and uphill to boot. About 1 o'clock we got behind some rocks in a side nullah, and drank our coffee and ate the biscuits and cheese we had brought in our pockets. The tiffin basket was left behind that day, as the coolies had enough to carry if we got a burrhel. The shikari and the other three men went ahead a little and scanned the hillside. We looked round in every direction too, but nothing was to be seen, not a sign of life; an occasional kite flying across made the only movement in the whole landscape. Then we noticed the shikari had the telescope out, and soon they signed to R. to go and look.

A herd had been spotted on the opposite hillside, hardly visible to the naked eye, but very distinct through the telescope. After a short discussion about which would be the best route to take, R. and the shikari and the local man dropped down to the stream, and climbed up where a natural wall of stone hid them from the part of the hillside where the burrhel were feeding. I watched through the telescope. The herd was feeding, but slowly moving uphill as they fed, further and further away from the place where R. had got to. I could count nine, but probably there were more; there were three rams with fine heads. It was very interesting seeing them so clearly, one scratching its head with a hind foot, and two boxing like a pair of billy-goats. I specially noticed one with very dark marking, quite black on the chest and down the front of its legs; this one had the largest horns.

By the time R. reached the "wall" they were out of range, and fresh plans of attack had to be made; a wide detour, coming down almost to the stream before they could climb up behind another ridge of rock. By this time the herd had got wind of their whereabouts and were going fairly fast uphill. Through the telescope I saw the two shikaris and R. cross a very steep shale bank, then a high ridge of rock. At that moment the tiffin coolies asked for the telescope. I heard a shot, but could see nothing. A few minutes later I saw all three sitting amongst the rocks; R. was getting a new grass shoe put on, as he had lost one during the climb. I continued to watch intently through the telescope after that, and saw one man at a time climbing up. Then I heard another shot, but I did not see the herd again. They were probably climbing to the top of the hill by a hollow out of sight from where I was sitting. It seemed only a few minutes later when there were shouts to the tiffin coolies, and both dropped down to the stream and climbed up the other side. I could only imagine the shots were successful, and the tiffin coolies were wanted probably to bring the burrhel down. Soon afterwards, still through the telescope, I saw R. coming down the hill with Chota Subhana, the latter carrying the rifle and the other the telescope. I soon heard all about it. He had got the black-breasted one which looked the best in the herd.

I had meantime moved into a circle of rocks for shelter, as the wind was bitterly cold, and there had been a shower of snow. While we drank the rest of the coffee, I got the details of the stalk, then we started off for home. It was early in the day, only 1.30. We had sighted the herd at 10 o'clock, and the shots were fired about 12.30.

It was a good tramp back to Kaisser by the same rocky road. We had several drinks from the stream, and we stopped for one short rest at the top of the gorge, when a little stone marten came out and looked at us, only a few yards away.

We got back to camp about 3.30. Chota Subhana had gone on ahead to send two village men up to help to bring down the burrhel, and we met the men on the path by the Indus. Tea was ready and we were glad the teapot was a big one. There was no milk, but we found two drops of lemon essence in each cup very refreshing.

We decided on a rest next day; partly to get our mail ready before sending the coolie to Leh for letters. The weather was delightful; just a touch of frost in the early mornings. After giving out stores and seeing some washing done, we got under the shelter of a stone dyke, and got on with our mail.

I had what I felt to be a well-earned rest after tiffin, and R. slept outside. Khansamah came and told me he had a very special dinner for us; as he had now plenty of meat, he gave us a delicious clear soup. It was indeed a treat, and with stewed hare made an excellent dinner.

(*To be continued.*)

Current Literature.

AYKROYD, W. R. **Diet in Relation to Small Incomes.** *Quarterly Bull. Health Organization, League of Nations.* Geneva, 1933, v. 2, 130-53. [Refs. in footnotes.]

It is estimated that the diet of an unemployed man should provide about 2,500 calories. In order to construct a low cost adequate diet the minimal requirements of the essential foodstuffs must be provided; protein should have a minimum value of 70 grammes daily, of which 35 grammes is of animal origin, and a minimum of 56 grammes of fat is required. The vitamins must also be supplied, but the exact amounts required are still unknown. Of the minerals, calcium, phosphorus, iron and iodine are of chief importance, and the fact that children and pregnant women require larger amounts of calcium than the adult must be allowed for. A low cost adequate diet has been constructed based on English dietary habits and calculated at 1932-33 prices which provides daily 2,505 calories at an estimated cost of 5s. 9d. weekly. This diet is moderately satisfactory as regards quality, providing 81 grammes of protein (36 grammes animal) and

88 grammes of fat, whilst other food factors are present in fairly adequate amounts. It contains 5 pints of milk weekly, which is somewhat larger than is found in the average working class diet. On the basis of present unemployment allowances, the percentage of the allowance that would be spent on this diet varies from 36 in the case of a single man to 63 in the case of a man, wife and 3 children. Other low cost diets have been constructed in Germany, and are essentially similar except in the variety of foods provided. The question of improving the diet of the very poor, unemployed or otherwise, depends in the first place on the relation of the income to the cheapest adequate diet. In Germany the unemployment benefit is often not sufficient to provide this low cost adequate diet, and the person must live on a reduced diet largely made up of the cheapest foods, such as bread, potatoes and margarine. It has been shown that in poor families the type of diet provided is very dependent on "maternal efficiency," and therefore education of the mothers should be capable of bringing about improvement in the diet. Much tact and skill had to be used in propaganda of this kind when directed to a population struggling on an inadequate income.

[Much statistical information regarding the diets of German, English and American working class families has been collected from various sources and in the summarized form, as presented in this article, should be useful to public health authorities.] H. N. H. Green.

Reprinted from "Bulletin of Hygiene," Vol. 8, *No.* 8.

American Public Health Association Year Book, 1932-1933. (*Supp. Amer. J. Pub. Health.* 1933, v. 23, June, 126—33). **Taste and Odour Removal Processes.** [Report of Committee on Water Supply, J. R. Bayliss, Chairman.]

The methods of taste and odour removal considered in this report are the ammonia-chlorine, activated carbon, aeration, high chlorination, ozone and potassium permanganate treatments. The use of ammonia-chlorine is becoming very extensive for it has the advantages that it eliminates chlorine and chlorophenol tastes, it retards or prevents after-growths, reduces the amount of chlorine necessary to sterilize the water, is possibly more effective than chlorine alone as a bactericide and allows a high residual chlorine to be maintained. The introduction of the method has resulted in much greater purity of the water as judged by the bacterial analysis. Treatment is usually applied after filtration, the ammonia being first added in the form either of ammonium sulphate, ammonia solution, or of anhydrous ammonia which is supplied in the liquid form in steel cylinders. This ammonia-chlorine process is chiefly of value in the prevention of chlorine and chlorophenol tastes. Activated carbon is also being extensively used for the removal of all kinds of tastes and odours. The powdered carbon is added to and mixed with the water which may then be allowed to sediment before filtration. In a few places water is filtered through beds

of granular activated carbon. Carbon is extremely effective in removing algal tastes and is used chiefly to remove tastes of that type. It also removes chlorophenol tastes and chlorine, but for the latter purpose a high dosage is required. Aeration is used effectively for the removal of certain tastes but it is not successful with all of them.

Superchlorination followed by dechlorination with sodium bisulphite has been adopted with success by some plants during periods when there is considerable pollution or when the natural taste or odour of the water is very pronounced. The use of ozone although a more costly process is being extended gradually for, in addition to being effectively bactericidal, it will also remove many of the tastes and odours of water. It is, however, a treatment which should probably be used only in conjunction with chlorine or chloramine. Potassium permanganate is still used as an effective remover of certain tastes and odours but it is doubtful if it is cheaper than some of the other methods of elimination. It is important in considering all the available methods of treatment to understand that each taste and odour condition is an individual problem requiring careful study to determine the best and most economical method of treatment.

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subserving the eye, including the optic nerve and its central connections, the path of the light reflex and the involuntary nervous system.

The development of the eye, and the comparative anatomy of the organ are dealt with in the last two chapters.

While all the illustrations attain a high standard, those drawn by Mr. A. K. Maxwell from the author's dissections of the orbit are outstanding.

Throughout the book brief clinical notes in italics are given where appropriate, and each chapter is concluded by a bibliography.

Notices.

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These courses of instruction, in addition to providing simple rules for guidance in regard to personal hygiene and preparation for life in the Tropics, will also embrace a short account of some of the more common diseases, with advice in regard to measures of protection and self-treatment.

The synopsis and other particulars can be obtained from the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.

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C.N. = Clinical and other Notes.
C.L. = Current Literature.

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Journal

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EDITED BY

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MANAGER:

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VOL. LXII.

January—June, 1934.

JOHN BALE, SONS & DANIELSSON, LTD.

83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W. 1.

No. 1. January, 1934. Vol. LXII.

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ISSUED MONTHLY

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Journal of the Royal Army Medical Corps.

Original Communications.

TRAINING OF THE R.A.M.C. OFFICER IN MEDICAL DUTIES IN THE FIELD.

By MAJOR-GENERAL J. A. HARTIGAN, C.B., C.M.G., D.S.O., K.H.P.

THE provision of adequate training for R.A.M.C. officers in medical duties in the field has become a matter of much difficulty owing to the shortage of regular officers. Such training becomes increasingly necessary as the number of officers with war experience diminishes. Most branches of the Service are now organized on divisional lines in time of peace, and their field training is thereby much facilitated. The Medical Service is an exception, and will of necessity always remain so, because our first consideration must be the efficient staffing of hospitals, and a divisional organization would in most stations seriously interfere with the professional duties of the Corps.

Second in importance only to the treatment of the sick comes the training of the R.A.M.C. officer for war. It is not suggested that medical organization and the handling of medical units in the field is a life study, but an adequate knowledge of the subject is essential for every regular R.A.M.C. officer, and the acquisition of such knowledge is in no way incompatible with professional zeal and efficiency.

While medical organization in general can be learned from a book, a sound knowledge of the tactical handling of mobile medical units can only be acquired by practical training, and it is in the provision of such training that administrative officers are now finding much difficulty.

Opportunities vary in different commands, but one or more of the

following methods are usually available: (1) War games; (2) administrative exercises; (3) tactical exercises on the ground with or without troops; (4) R.A.M.C. staff exercises; (5) R.A.M.C. camps of training.

While (1) (2) and (3) are useful and afford an opportunity of working with officers of other branches of the Army, the medical aspect of the problems is not usually considered in very much detail, and the knowledge gained by the R.A.M.C. officer is not always commensurate with the time involved.

Our most satisfactory methods of instruction are (4) and (5)—R.A.M.C. staff exercises, and camps of training. By means of staff exercises a large number of officers are afforded valuable training in a short period and at a time of the year when they can be best spared from their normal duties. For the young officer, however, with no war experience, the R.A.M.C. camp of training affords in my judgment the best method of instruction. It would be desirable if such a camp could be held annually in each of the large commands at home, and if this be not possible, at least one such camp should be organized each year, lasting several weeks, during which time a large number of officers and other ranks from the various commands could be passed through a course. A complete field ambulance would be necessary for all such camps, thus affording an opportunity (the only one in times of peace) of seeing what the unit looks like and of studying its organization in detail.

The few such camps that have been held since the War were associated with divisional training, the field ambulance being attached to one or other of the brigades for specific schemes. This arrangement is not in my experience satisfactory, as the fact that only one of the three brigades has a field ambulance attached to it makes the organization "lop sided" and unreal, and for that reason it is suggested that when only one field ambulance is available it should only take part in brigade exercises. But the training camp itself should be independent, and should be able to arrange its own programme of training to suit the personnel under instruction. When it is desired to attach the field ambulance to a brigade for a specific exercise, arrangements could be made by the command concerned.

Collection of casualties is sometimes tacked on to divisional schemes when a field ambulance is available. This does not usually work well, for the reason that the cease fire often brings the exercise to an end just about the time that the collection and evacuation of wounded are getting into full swing.

For training in the collection of casualties it is desirable to have special schemes (with or without combatant troops) in which the tactical side is recognized to be of secondary importance.

As, however, the Army is organized on a divisional basis, and as field ambulances are divisional troops, it is of the utmost importance not only from the point of view of the R.A.M.C. officer, but also from that of divisional commanders and staffs, that the medical services should take

an active part in divisional training. The ideal method would, of course, be to organize three field ambulances for all divisional manœuvres, but as this is out of the question some alternative method is most desirable. A possible method would seem to be the employment of skeleton units, the strength of which would depend on the numbers of officers and other ranks that could be made available. Three such units should be provided for divisional exercises, and however small they should be organized as a headquarters and two companies. The amount of transport will also depend on local circumstances, and the same remark applies to medical and ordnance equipment, which need not be elaborate. This equipment should, however, be in addition to that allowed for the treatment and accommodation of the actual sick in the various standing camps, which need not be removed from those camps throughout the training.

A certain number of R.A.M.C. officers and other ranks have of necessity to accompany all formations on manœuvres. They are employed on purely medical and sanitary duties which occupy (at most) three or four hours a day. They are afforded no opportunity of studying the various schemes—very often they do not even see operation orders—and they do not usually attend conferences. There is no occasion for them to study the location of A.D.S.'s or M.D.S.'s or even to practise map reading. In fact from the point of view of training for war, their time in camp is completely wasted. With very little additional personnel, the R.A.M.C. detachment could be organized as a skeleton field ambulance which could take part in all the exercises and thus afford officers and N.C.O.s an invaluable opportunity of studying the disposition of field ambulances in war and of writing orders and field messages. Commanders and staff officers would be able to consider the arrangements for the collection of casualties and to include medical paragraphs in their Operation Orders and Administrative Instructions. Further, many regimental officers would learn something of the functions of medical units in the field, and a closer liaison than now exists would be established between the Medical Services and other branches of the Army.

It is therefore suggested (and this is the sole object of this article) that in future, instead of sending R.A.M.C. personnel to form a "reception hospital," every force of the strength of an infantry or cavalry brigade or more should have the appropriate number of skeleton field ambulances with it, however attenuated the skeletons may be, and that we should discontinue using nondescript terms such as "reception hospitals" and adopt the nomenclature used in war.

This system was adopted for the recent training of the 2nd Division on Salisbury Plain. Two skeleton field ambulances were organized by the Aldershot Command and one by the London District as the Guards Brigade formed part of that division. The establishment allowed for these units which is given below, was of a purely experimental nature, and it is realized that in some commands it would not be possible to furnish the numbers of

I had meantime moved into a circle of rocks for shelter, as the wind was bitterly cold, and there had been a shower of snow. While we drank the rest of the coffee, I got the details of the stalk, then we started off for home. It was early in the day, only 1.30. We had sighted the herd at 10 o'clock, and the shots were fired about 12.30.

It was a good tramp back to Kaisser by the same rocky road. We had several drinks from the stream, and we stopped for one short rest at the top of the gorge, when a little stone marten came out and looked at us, only a few yards away.

We got back to camp about 3.30. Chota Subhana had gone on ahead to send two village men up to help to bring down the burrhel, and we met the men on the path by the Indus. Tea was ready and we were glad the teapot was a big one. There was no milk, but we found two drops of lemon essence in each cup very refreshing.

We decided on a rest next day; partly to get our mail ready before sending the coolie to Leh for letters. The weather was delightful; just a touch of frost in the early mornings. After giving out stores and seeing some washing done, we got under the shelter of a stone dyke, and got on with our mail.

I had what I felt to be a well-earned rest after tiffin, and R. slept outside. Khansamah came and told me he had a very special dinner for us; as he had now plenty of meat, he gave us a delicious clear soup. It was indeed a treat, and with stewed hare made an excellent dinner.

(*To be continued.*)

Current Literature.

AYKROYD, W. R. **Diet in Relation to Small Incomes.** *Quarterly Bull. Health Organization, League of Nations.* Geneva, 1933, v. 2, 130-53. [Refs. in footnotes.]

It is estimated that the diet of an unemployed man should provide about 2,500 calories. In order to construct a low cost adequate diet the minimal requirements of the essential foodstuffs must be provided; protein should have a minimum value of 70 grammes daily, of which 35 grammes is of animal origin, and a minimum of 56 grammes of fat is required. The vitamins must also be supplied, but the exact amounts required are still unknown. Of the minerals, calcium, phosphorus, iron and iodine are of chief importance, and the fact that children and pregnant women require larger amounts of calcium than the adult must be allowed for. A low cost adequate diet has been constructed based on English dietary habits and calculated at 1932-33 prices which provides daily 2,505 calories at an estimated cost of 5s. 9d. weekly. This diet is moderately satisfactory as regards quality, providing 81 grammes of protein (36 grammes animal) and

88 grammes of fat, whilst other food factors are present in fairly adequate amounts. It contains 5 pints of milk weekly, which is somewhat larger than is found in the average working class diet. On the basis of present unemployment allowances, the percentage of the allowance that would be spent on this diet varies from 36 in the case of a single man to 63 in the case of a man, wife and 3 children. Other low cost diets have been constructed in Germany, and are essentially similar except in the variety of foods provided. The question of improving the diet of the very poor, unemployed or otherwise, depends in the first place on the relation of the income to the cheapest adequate diet. In Germany the unemployment benefit is often not sufficient to provide this low cost adequate diet, and the person must live on a reduced diet largely made up of the cheapest foods, such as bread, potatoes and margarine. It has been shown that in poor families the type of diet provided is very dependent on "maternal efficiency," and therefore education of the mothers should be capable of bringing about improvement in the diet. Much tact and skill had to be used in propaganda of this kind when directed to a population struggling on an inadequate income.

[Much statistical information regarding the diets of German, English and American working class families has been collected from various sources and in the summarized form, as presented in this article, should be useful to public health authorities.] H. N. H. Green.

Reprinted from "Bulletin of Hygiene," Vol. 8, No. 8.

American Public Health Association Year Book, 1932-1933. (*Supp. Amer. J. Pub. Health.* 1933, v. 23, June, 126—33). **Taste and Odour Removal Processes.** [Report of Committee on Water Supply, J. R. Bayliss, Chairman.]

The methods of taste and odour removal considered in this report are the ammonia-chlorine, activated carbon, aeration, high chlorination, ozone and potassium permanganate treatments. The use of ammonia-chlorine is becoming very extensive for it has the advantages that it eliminates chlorine and chlorophenol tastes, it retards or prevents after-growths, reduces the amount of chlorine necessary to sterilize the water, is possibly more effective than chlorine alone as a bactericide and allows a high residual chlorine to be maintained. The introduction of the method has resulted in much greater purity of the water as judged by the bacterial analysis. Treatment is usually applied after filtration, the ammonia being first added in the form either of ammonium sulphate, ammonia solution, or of anhydrous ammonia which is supplied in the liquid form in steel cylinders. This ammonia-chlorine process is chiefly of value in the prevention of chlorine and chlorophenol tastes. Activated carbon is also being extensively used for the removal of all kinds of tastes and odours. The powdered carbon is added to and mixed with the water which may then be allowed to sediment before filtration. In a few places water is filtered through beds

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The sixth chapter presents an admirable account of the cranial nerves

subserving the eye, including the optic nerve and its central connections, the path of the light reflex and the involuntary nervous system.

The development of the eye, and the comparative anatomy of the organ are dealt with in the last two chapters.

While all the illustrations attain a high standard, those drawn by Mr. A. K. Maxwell from the author's dissections of the orbit are outstanding.

Throughout the book brief clinical notes in italics are given where appropriate, and each chapter is concluded by a bibliography.

Notices.

"WELLCOME" BRAND ANTI-PNEUMOCOCCUS SERA.

APPROXIMATELY half of all cases of lobar pneumonia in various parts of the world are caused by pneumococcus Type I or II. Therefore many physicians wish to give mixed I + II serum immediately the patient is seen. For this purpose "Wellcome" Brand Concentrated Anti-Pneumococcus Serum, Type I + II, is available. Each phial of the mixed concentrated serum contains 10,000 units of each antitoxin.

The type of the infecting cause is ascertained, and if it belongs to Type I or II, the appropriate serum is used for treatment. Both Concentrated and Unconcentrated Anti-Pneumococcus Sera of each type are issued. "Wellcome" Brand Sera are prepared at The Wellcome Physiological Research Laboratories, Beckenham, Kent, and supplied by Burroughs Wellcome and Co.

A system of Telegraphic Code Words which simplifies the ordering of these products and ensures correctness may be found in Wellcome's Medical Diary or Burroughs Wellcome and Co.'s Trade Price List.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (UNIVERSITY OF LONDON).

THE next series of Lectures and Demonstrations on Tropical Hygiene, which are intended for men and women outside the medical profession proceeding to the Tropics, will be given by Lieutenant-Colonel G. E. F. Stammers, O.B.E., M.R.C.S., L.R.C.P., D.P.H., from December 4 to 13, 1933. The course comprises eight lectures, which will be given from 5 to 6.30 p.m. on each day.

These courses of instruction, in addition to providing simple rules for guidance in regard to personal hygiene and preparation for life in the Tropics, will also embrace a short account of some of the more common diseases, with advice in regard to measures of protection and self-treatment.

The synopsis and other particulars can be obtained from the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.

INDEX TO VOLUME LXI.

C.N. = Clinical and other Notes.
C.L. = Current Literature.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a nom-de-plume.

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Journal

of the

Royal Army Medical Corps

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EDITED BY

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VOL. LXII.

January—June, 1934.

JOHN BALE, SONS & DANIELSSON, LTD.

83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W. 1.

No. 1. January, 1934. Vol. LXII.

Journal

OF THE Royal Army Medical Corps

IN · ARDUIS · FIDELIS

ISSUED MONTHLY

EDITOR.
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ASSISTANT EDITOR.
LIEUTENANT-COLONEL A. DAWSON, O.B.E., R.A.M.C.

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JOHN BALE, SONS & DANIELSSON, LTD.
83-91, GREAT TITCHFIELD STREET, LONDON, W.1

Price Two Shillings net

VOL. LXII. JANUARY, 1934. No. 1

Journal
of the
Royal Army Medical Corps.

Original Communications.

TRAINING OF THE R.A.M.C. OFFICER IN MEDICAL DUTIES IN THE FIELD.

BY MAJOR-GENERAL J. A. HARTIGAN, C.B., C.M.G., D.S.O., K.H.P.

THE provision of adequate training for R.A.M.C. officers in medical duties in the field has become a matter of much difficulty owing to the shortage of regular officers. Such training becomes increasingly necessary as the number of officers with war experience diminishes. Most branches of the Service are now organized on divisional lines in time of peace, and their field training is thereby much facilitated. The Medical Service is an exception, and will of necessity always remain so, because our first consideration must be the efficient staffing of hospitals, and a divisional organization would in most stations seriously interfere with the professional duties of the Corps.

Second in importance only to the treatment of the sick comes the training of the R.A.M.C. officer for war. It is not suggested that medical organization and the handling of medical units in the field is a life study, but an adequate knowledge of the subject is essential for every regular R.A.M.C. officer, and the acquisition of such knowledge is in no way incompatible with professional zeal and efficiency.

While medical organization in general can be learned from a book, a sound knowledge of the tactical handling of mobile medical units can only be acquired by practical training, and it is in the provision of such training that administrative officers are now finding much difficulty.

Opportunities vary in different commands, but one or more of the

following methods are usually available: (1) War games; (2) administrative exercises; (3) tactical exercises on the ground with or without troops; (4) R.A.M.C. staff exercises; (5) R.A.M.C. camps of training.

While (1) (2) and (3) are useful and afford an opportunity of working with officers of other branches of the Army, the medical aspect of the problems is not usually considered in very much detail, and the knowledge gained by the R.A.M.C. officer is not always commensurate with the time involved.

Our most satisfactory methods of instruction are (4) and (5)—R.A.M.C. staff exercises, and camps of training. By means of staff exercises a large number of officers are afforded valuable training in a short period and at a time of the year when they can be best spared from their normal duties. For the young officer, however, with no war experience, the R.A.M.C. camp of training affords in my judgment the best method of instruction. It would be desirable if such a camp could be held annually in each of the large commands at home, and if this be not possible, at least one such camp should be organized each year, lasting several weeks, during which time a large number of officers and other ranks from the various commands could be passed through a course. A complete field ambulance would be necessary for all such camps, thus affording an opportunity (the only one in times of peace) of seeing what the unit looks like and of studying its organization in detail.

The few such camps that have been held since the War were associated with divisional training, the field ambulance being attached to one or other of the brigades for specific schemes. This arrangement is not in my experience satisfactory, as the fact that only one of the three brigades has a field ambulance attached to it makes the organization "lop sided" and unreal, and for that reason it is suggested that when only one field ambulance is available it should only take part in brigade exercises. But the training camp itself should be independent, and should be able to arrange its own programme of training to suit the personnel under instruction. When it is desired to attach the field ambulance to a brigade for a specific exercise, arrangements could be made by the command concerned.

Collection of casualties is sometimes tacked on to divisional schemes when a field ambulance is available. This does not usually work well, for the reason that the cease fire often brings the exercise to an end just about the time that the collection and evacuation of wounded are getting into full swing.

For training in the collection of casualties it is desirable to have special schemes (with or without combatant troops) in which the tactical side is recognized to be of secondary importance.

As, however, the Army is organized on a divisional basis, and as field ambulances are divisional troops, it is of the utmost importance not only from the point of view of the R.A.M.C. officer, but also from that of divisional commanders and staffs, that the medical services should take

an active part in divisional training. The ideal method would, of course, be to organize three field ambulances for all divisional manœuvres, but as this is out of the question some alternative method is most desirable. A possible method would seem to be the employment of skeleton units, the strength of which would depend on the numbers of officers and other ranks that could be made available. Three such units should be provided for divisional exercises, and however small they should be organized as a headquarters and two companies. The amount of transport will also depend on local circumstances, and the same remark applies to medical and ordnance equipment, which need not be elaborate. This equipment should, however, be in addition to that allowed for the treatment and accommodation of the actual sick in the various standing camps, which need not be removed from those camps throughout the training.

A certain number of R.A.M.C. officers and other ranks have of necessity to accompany all formations on manœuvres. They are employed on purely medical and sanitary duties which occupy (at most) three or four hours a day. They are afforded no opportunity of studying the various schemes—very often they do not even see operation orders—and they do not usually attend conferences. There is no occasion for them to study the location of A.D.S.'s or M.D.S.'s or even to practise map reading. In fact from the point of view of training for war, their time in camp is completely wasted. With very little additional personnel, the R.A.M.C. detachment could be organized as a skeleton field ambulance which could take part in all the exercises and thus afford officers and N.C.O.s an invaluable opportunity of studying the disposition of field ambulances in war and of writing orders and field messages. Commanders and staff officers would be able to consider the arrangements for the collection of casualties and to include medical paragraphs in their Operation Orders and Administrative Instructions. Further, many regimental officers would learn something of the functions of medical units in the field, and a closer liaison than now exists would be established between the Medical Services and other branches of the Army.

It is therefore suggested (and this is the sole object of this article) that in future, instead of sending R.A.M.C. personnel to form a "reception hospital," every force of the strength of an infantry or cavalry brigade or more should have the appropriate number of skeleton field ambulances with it, however attenuated the skeletons may be, and that we should discontinue using nondescript terms such as "reception hospitals" and adopt the nomenclature used in war.

This system was adopted for the recent training of the 2nd Division on Salisbury Plain. Two skeleton field ambulances were organized by the Aldershot Command and one by the London District as the Guards Brigade formed part of that division. The establishment allowed for these units which is given below, was of a purely experimental nature, and it is realized that in some commands it would not be possible to furnish the numbers of

N.C.O.s and men suggested, the majority of whom in this instance were provided by the R.A.M.C. Depot. The numbers are, however, of secondary importance, as if necessary an intelligent N.C.O. with a motor ambulance could represent an A.D.S.

The training is primarily for the officers, and for that reason as many as can be spared should be detailed for the duty. We had hoped to send four with each unit (three to be available for the various exercises and one to remain in camp), but owing to departures for foreign service the number had at the last moment to be reduced to three.

2ND DIVISION TRAINING, 1933. ESTABLISHMENT OF SKELETON FIELD AMBULANCES.

PERSONNEL.

R.A.M.C.	H.Q.				"A" Coy.				"B" Coy.				Total
Officers		1				1				1			3
	S/Sjts. and Sjts.	Corporals	Privates	Total	Serjeants	Corporals	Privates	Total	Serjeants	Corporals	Privates	Total	
Clerks			1	1									1
Regimental Duties	1			1	1			1	1			1	3
Nursing Duties		1	3	4		1	1	2		1	1	2	8
Wagon Orderlies			2	2			1	1			1	1	4
General Duties and Sanitation			3	3									3
Stretcher Bearers						1	8	9		1	8	9	18
Total R.A.M.C.--	1	1	9	11	1	2	10	13	1	2	10	13	37
Attached:													
Grooms for riding horses ..							1	1			1	1	2
Horse Transport drivers ..							2	2			2	2	4
Mechanical Transport drivers..			4	4									4
Grand Total	1	1	13	15	1	2	13	16	1	2	13	16	47

TRANSPORT.

	H.Q.		"A" Coy.		"B" Coy.		Total	
	Vehicles	Horses	Vehicles	Horses	Vehicles	Horses	Vehicles	Horses
Motor Cars, light	1						1	
Motor Ambulances	2						2	
Lorry, light	1						1	
Wagons, G.S. limbered ..			1	2	1	2	2	4
Wagons, Ambulance ..			1	2	1	2	2	4
Horses, riding (Officers) ..				1		1		2
Horses, riding (Grooms) ..				1		1		2

In carrying out the experiment we were fortunate in having the services of Colonel H. B. Kelly, D.S.O. (who had considerable experience in field

ambulance work during the War), as A.D.M.S. and of Major E. U. Russell, M.C. (from the Scottish Command) as D.A.D.M.S.

In his report at the conclusion of the manœuvres, Colonel Kelly states that in his opinion "three cadre field ambulances constitute a much more valuable means of training than the formations of one complete field ambulance for the division." The latter method, he adds, would completely nullify the advantage of having an A.D.M.S. and a D.A.D.M.S.

Colonel Kelly advocates slight increases in the personnel, and the allotment of two additional motor ambulances to be under the direct orders of the A.D.M.S. to deal with emergencies, and to be available for duties at the permanent camps when the main bodies are engaged in a tactical exercise.

He also strongly recommends that each cadre field ambulance should have a motor cyclist. This is most important, but unfortunately none was available in this instance as all were employed with the various signal units which took part in the training.

But, as previously stated, the establishment and equipment allowed for skeleton field ambulances would have to depend on local circumstances. The main point is that, with the object of training R.A.M.C. officers and other ranks for war, we should endeavour to form such units in all brigade and divisional exercises in the future, and not be content with providing R.A.M.C. detachments for the sole purpose of dealing with the actual sick.

———

THE USE OF STEAM COOKING APPARATUS TO DISINFECT CROCKERY.

Major H. A. SANDIFORD, M.C.,
Royal Army Medical Corps.

AND

Major J. H. C. WALKER,
Royal Army Medical Corps.

In an endeavour to ensure adequate cleanliness of crockery and thus prevent in part the spread of saliva-borne disease, it was thought that use might be made of the steam usually available in the men's cookhouses. Experiments were therefore undertaken to determine whether the steam cooking apparatus could be employed for this purpose.

Disinfection of Crockery in the Warren Apparatus.

The type of Warren apparatus used in these experiments is somewhat similar to that shown in Schedule M of the "Manual of Military Cooking and Dietary, 1924," but differs from it in the following particulars : (*a*) The apparatus used is considerably larger ; (*b*) the area above the oven (occupied by hot-plates in the Schedule M) is larger and is taken up by three steaming tins placed side by side, each bearing the letter E and referred to in the experiments as E 1, E 2 and E 3 respectively (*vide* fig. 1).

Two double F tins are fitted on shelves on the sides of the apparatus. The upper F tin on each side is without a floor and so communicates with the lower F tin from which it cannot be used separately. The lower F tins, however, can be used without the upper portions and were, in fact, so used for the experiments, in which they are referred to as F 1 and F 2 respectively. The F tins are slightly larger than the E tins.

Steam, at atmospheric pressure, enters each steaming tin at one end, near the bottom, and escapes around the edges of the lid which, though well fitting, is not steam tight; there is, therefore, no "downward displacement" of air in the tins. Steam is controlled by a tap on the steam jet fitting into each tin, and it is thus possible to use any number of tins up to five at the same time. Care was taken before each experiment to see that a full head of steam was available as shown by its escape through the safety valve fitted to the boiler.

By trial it was found that twenty-six pounds of coal were used in lighting the fire and getting up steam ; part of this expenditure would not normally be charged to the disinfection of crockery as the fire would be already lit for cooking purposes. It was also determined that twelve

pounds of coal were sufficient to keep up steam for one and three quarter hours.

The experiments were carried out on two similar types of Warren apparatus and for convenience these are referred to as X and Y respectively.

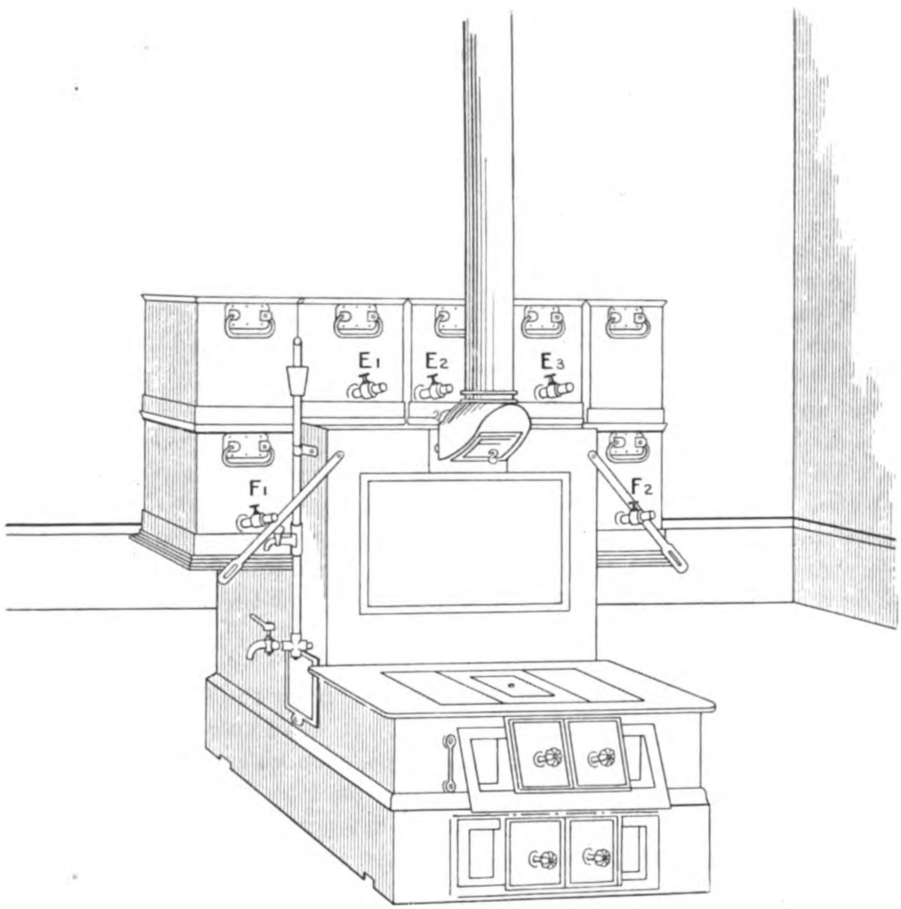

FIG. 1.

Capacity of the Warren Apparatus to Hold Crockery.

The plates used throughout the experiments were mixed soup and dinner plates—the former being much the more numerous. The plates were of ten-inch diameter, and it was found possible to accommodate two rows of plates alongside each other in a tin, the plates being on their edges and the rows running across the breadth of the tin. The mugs were arranged in layers in the tins, three layers to a tin, the mugs being upright, inverted or placed on their sides. When on their sides the mugs could be placed with their mouths facing away from or towards the steam entrance.

The following numbers of plates and mugs can be accommodated in the tins :—

			Per tin
(*a*) *Plates.*	E Tin.—2 rows of 32 plates (10 inches diameter) ..	..	64
	F Tin.—2 rows of 33 plates (10 inches diameter) ..	..	66

Total capacity of apparatus $= \begin{cases} 64 \times 3 = 192 \\ 66 \times 2 = 132 \end{cases} = 324$ plates.

(*b*) *Mugs.*	E Tin.—38 mugs inverted—2 complete and 1 incomplete layer, or 40 mugs on side ..	3 complete layers
	F Tin.—44 mugs inverted	3 complete layers
	40 mugs on side	3 complete layers

Total capacity of apparatus $= \begin{cases} \text{Mugs, inverted—202.} \\ \text{Mugs, on side—200.} \end{cases}$

The soup plates were arranged on their edges in rows as already described and the mugs in layers.

A sterile cotton thread was laid on the plate to be tested, and over the thread was poured two to three cubic centimetres of a twenty-four hours old broth culture of *Bacillus coli communis*, and the thread stirred in the culture till completely soaked. A second plate was then laid over the thread and the two plates inserted on their edges in the row. On only one occasion did a thread fall out between the two plates on to the floor of a tin. The threads were usually inserted between the two plates at each end of a row. After the first day's experiments the plates bearing the sterile threads and those in contact with them were boiled for a short time beforehand and allowed to cool before use. This was found sufficient to kill off non-sporing organisms, but contamination with sporing bacilli did occur.

In the case of the mugs the sterile thread was placed inside the mug and the culture of *B. coli* poured on top of it. After the thread was soaked the mug was placed in position in the tin. It was found that the threads remained adherent to the inside of the mugs, even when inverted after the first day's experiments. Boiled mugs were used to hold the threads, but contaminations were again found in some instances.

The mugs containing the threads were in all cases placed at the end of the tin farthest from the steam entrance.

At the conclusion of each experiment the threads were recovered from the plates and mugs and placed in tubes of lactose broth with an indicator. These were incubated at 37° C. and the results read at the end of twenty-four and forty-eight hours.

During the last experiment of the day, on every occasion but one, the flask containing the remnant of the broth culture of *B. coli* was placed in the tin or wooden box being used for the experiment, and a subculture was made later in lactose broth. It is noteworthy that on every occasion the culture in the flask was killed.

A control subculture of the test organism was made each day to test the media and original culture.

Summary of Experiments.—Twenty-six experiments for the disinfection

of plates in the Warren apparatus were carried out. In fourteen experiments all the threads exposed (89) were freed from the test organism. In eleven experiments out of 70 threads 49 were sterile and 21 showed presence of *B. coli*. In one experiment neither of the threads (2) was sterilized.

Relationship between Steaming Period and Number of Jets in Use.

Since the five jets of the Warren Apparatus are connected with the same boiler it is obvious that, when only one jet is open, the whole of the volume and pressure of steam is available for one tin, and that as more jets are opened the volume and pressure of steam available will be less for each tin. It would, therefore, be expected that the greater the number of tins to be heated at the same time, the longer would be the period of steaming required.

Table A shows the results of the experiments.

TABLE A.

Steam exposure	Number of Jets in Use				
	1	2	3	4	5
5 minutes	Yes (2) No (3)	No (1) (6 minutes)	—	—	—
10 minutes	—	Yes (5) (8 minutes)	No (1)	Yes (1) No (1)	No (2)
15 minutes	—	—	Yes (2)	No (1) Yes (1)	—
20 minutes	—	—	—	Yes (2)	Yes (1) No (1)
25 minutes	—	—	—	—	No (2)

(i) "Yes" = successful experiment.
(ii) "No" = unsuccessful experiment.
(iii) Figure in brackets indicates the number of times the experiment was carried out.

Table B shows in detail the numbers and percentages of threads freed from the test organisms (*B. coli*) under the varying conditions of time and number of jets in use.

Early on in the experiments it was noticed that the F tins did not give such good results as the E tins, and there was on several occasions a noticeable difference of temperature between them, the E tins being unbearably hot to the touch, whilst the F tins were markedly cooler. In compiling Table B it has been necessary, therefore, to distinguish between the results in the E and F tins.

The superiority of E tins is evident.

Allowing five minutes per jet per tin, ninety-six per cent of the threads on the plates in E tins were freed from *B. coli*, and eighty-two per cent of the threads in F tins.

TABLE B.

Number of jets in use	Duration of steaming	E Tin Results		F Tin Results	
		Threads freed from *B. coli*	Percentage freed	Threads freed from *B. coli*	Percentage freed
1	5 mins.	8 out of 10	80 per cent.	2 out of 6	33 per cent.
2	6 ,,	3 ,, 4	75 ,,	0 ,, 4	0 ,,
	10 ,,	18 ,, 18	100 ,,	16 ,, 16	100 ,,
3	10 ,,	3 ,, 4	75 ,,	—	—
	15 ,,	8 ,, 8	100 ,,	4 ,, 4	100 ,,
4	10 ,,	9 ,, 10	90 ,,	0 ,, 2	0 ,,
	15 ,,	10 ,, 10	100 ,,	4 ,, 6	66 ,,
	20 ,,	12 ,, 12	100 ,,	4 ,, 4	100 ,,
5	10 ,,	8 ,, 8	100 ,,	4 ,, 6	66 ,,
	20 ,,	10 ,, 11	91 ,,	4 ,, 4	100 ,,
	25 ,,	6 ,, 6	100 ,,	5 ,, 8	63 ,,
		95 out of 101	94 per cent.	43 out of 60	72 per cent.

Experiments were also carried out on two apparently similar Warren cookers, X and Y, to ascertain whether small constructional differences would influence the results. Table C shows the number of threads freed from the test organism and the number exposed in X and Y apparatus respectively under comparable conditions:—

TABLE C.

Jets in use	Exposure	Reference to experiments	Numbers of Threads							
			E Tins				F Tins			
			X Appts.		Y Appts.		X Appts.		Y Appts.	
			Ex-posed	Freed	Ex-posed	Freed	Ex-posed	Freed	Ex-posed	Freed
2	10 mins.	A. 1, 2, 4, 12	12	12	2	2	—	—	—	—
4	20 ,,	A. 23, 25	6	6	6	6	2	2	2	2
5	10 ,,	A. 6. 14	6	6	2	2	2	1	4	3
5	20 ,,	A. 33, 46	—	—	—	—	4	3	4	2

There was no marked differences in the results obtained in the two Warren cookers.

Twenty-nine experiments on the disinfection of mugs in the Warren apparatus were carried out. In fifteen experiments all the threads exposed (102) were freed from the test organisms. In fourteen experiments, out of 84 threads exposed, 53 were freed and 31 not freed.

Table D gives in detail the number and percentages of threads freed from the test organisms (*B. coli*) under the varying conditions of time and number of jets in use.

The E and F tins have been treated separately.

TABLE D.

Number of jets in use	Exposure	E Tins		F Tins	
		Threads freed from *B. coli*	Percentage freed	Threads freed from *B. coli*	Percentage freed
1	10 mins.	3 out of 3	100 per cent.	—	—
2	10 ,,	34 ,, 36	94 ,,	17 out of 21	81 per cent.
3	10 ,,	35 ,, 48	73 ,,	7 ,, 9	78 ,,
	15 ,,	27 ,, 27	100 ,,	—	—
4	10 ,,	2 ,, 3	66 ,,	1 ,, 3	33 ,,
5	10 ,,	3 ,, 3	100 ,,	1 ,, 3	33 ,,
	20 ,,	9 ,, 9	100 ,,	7 ,, 12	58 ,,
	25 ,,	9 ,, 9	100 ,,	—	—
		122 ,, 138	88 ,,	33 ,, 48	69 ,,

Table D shows the superiority of the E tins. Allowing five minutes per jet per tin, disinfection was obtained in ninety-seven per cent of threads in mugs in E tins and eighty-one per cent of threads in F tins.

Disinfection of Threads by Layers.

The direction taken by the flow of steam from its entrance at the end of an empty steaming tin to its exit around the edges of the lid, is influenced by the contents of the tin. When the tin is loaded the contents probably act as "baffle-plates," breaking the regular lines of flow and causing a wider dispersion of the steam throughout the tin. During this dispersion the steam, being lighter than air, has a constant tendency to rise towards the lid, and, on theoretical grounds, therefore, it would be expected that the contents of the tin at the lowest part and furthest from the steam entrance would receive the least heat. It was for this reason that the mugs to be tested were always placed at the end of the tin away from the steam entrance.

It should be noted that equal numbers of threads were exposed in the top, middle and bottom layers.

It was found that fewer threads were disinfected in the bottom layers due to the rising of steam in the tins.

Position of Mugs, Inverted, Upright, or on the Side.

In an attempt to determine whether the position of a mug influences the results of the experiments, it was decided that E tins must be compared with E tins, and F tins with F tins.

Bottom layer mugs must be compared with other bottom layers, middle with middle and top with top.

The period of exposure to steam and the number of jets in use must also be comparable.

Table E has been compiled, observing the above conditions, to show the number of threads in mugs freed and not freed from the test organisms, and also to indicate the position of the mugs.

Three groups of experiments are available for this analysis, and for convenience are referred to in Table E as Alpha, Beta and Gamma groups respectively. *Alpha*, 2 jets, ten minutes' exposure. *Beta*, 3 jets, ten minutes' exposure. *Gamma*, 5 jets, twenty minutes' exposure.

TABLE E.

(F = freed from test organisms. NF = Not freed from test organisms.)

Threads	Tins	Position of mugs	*Alpha*		*Beta*		*Gamma*	
			F	NF	F	NF	F	NF
Bottom layer..	E	Upright	1		1			
		Inverted	9	1	8	5	3	
		On the side	1			2		
	F	Upright						2
		Inverted	4	2	2			2
		On the side		1		1		
Middle layer	E	Upright						
		Inverted	8		5	4	3	
		On the side	3	1	7			
	F	Upright						
		Inverted	2					1
		On the side	4	1	2	1	2	
Top layer	E	Upright						
		Inverted	8		7	2	3	
		On the side	4		7			
	F	Upright						
		Inverted	2				2	
		On the side	5		3		2	

Table E shows no marked difference in favour of any particular position of the mugs, but a slight tendency for inversion to give better results as compared with the "on the side" position.

Conclusions.

It is practicable to disinfect plates and mugs in the Warren apparatus.

Allowing five minutes steaming per jet per tin, test organisms were killed in 96·5 per cent of cases in E tins and in 81·5 per cent in F tins.

The marked superiority of the E tins renders their sole use advisable where small amounts of crockery require disinfection and where it is imperative (e.g., amongst contacts of cerebrospinal meningitis) to ensure the best results.

It is probable that lengthening the steaming period per jet per tin would give even better results, especially in the case of F tins.

Where E and F tins are used together, it is immaterial whether mugs or plates are loaded into the E or F tins.

No differences in the results were found resulting from structural variations in the two Warren cookers used in the experiments.

It is considered that the results in similar types of apparatus would closely approximate.

The Warren apparatus used was not fitted with a pressure gauge; it is essential to see that a full head of steam is available as shown by the escape of steam through the valve on the boiler. Stoking is usually not necessary during the process of disinfection when the steaming period does not exceed thirty minutes and is best avoided if possible. If stoking be unavoidable, it should be efficiently performed in the method laid down in "Manual of Military Cooking and Dietary, 1924," p. 18.

Inefficient stoking was considered to be the cause of the poor results in some of the experiments, as the fire became "dead" when coal was introduced during the course of the experiment.

The arrangement of the crockery is important; plates should be arranged on their edges in rows across the breadth of the tins to permit of penetration by the steam; mugs should be inverted to allow the steam to displace the contained air.

Disinfection of Plates and Mugs in a Wooden Box Connected to the Warren Apparatus.

The wooden box used to contain the crockery was a zinc-lined ice chest of the following internal dimensions: Length, 30 inches; breadth, 19 inches; depth, 17 inches.

A hole was made through the centre of the lid and a piece of one inch lead piping inserted through the hole and allowed to project inside the box for 10 inches. A piece of rubber tubing 36 inches by 1⅜ inches was used to connect the metal pipe with an F jet on the Warren cooker. The box had the usual small orifice at one lower corner of its anterior aspect to allow melted ice to escape.

When connected to the Warren apparatus and the jet turned on, steam entered the box at its uppermost part, and after displacing the air in the box escaped through the water exit. The lid was not steam tight, but very little steam escaped when a suitable weight was placed on the lid. It will be seen that "downward displacement" disinfection was possible.

The plates used in the experiments were mixed soup and dinner plates 10 inches in diameter. The plates could be arranged in piles on the floor of the box or in rows on their edges on the floor. It was found possible to accommodate three such rows alongside one another. The mugs were placed on a wooden rack which rested on the plates. The mugs were inverted, upright, or lying on the side on the rack.

The box fully loaded was found to contain 122 plates and 22 mugs resting on the rack.

A technique similar to that already described was followed. A twenty-four hours' broth culture of *B. coli* provided the test organism. The experiments were carried out on the same days as the experiments on the Warren apparatus.

With plates in rows the test plates were inserted at the ends of the rows; with plates in piles the test plates were at the top and bottom of

the piles. Boiled crockery was used after the first experiment, but sporing organisms were found to survive.

Nine experiments were carried out, and these are divisible into two groups.

In the first group steam was allowed to flow into the box for arbitrarily fixed periods.

In the second steam was allowed to flow until it issued freely at the water exit, and thereafter for one minute or two minutes. True "downward displacement" disinfection was attempted in this second group.

In each of the experiments in the first group a pile of plates and a row of plates were exposed to the steam at the same time. Each pile and row contained respectively two test threads soaked in the test organisms.

Table F shows the improvement in results with the longer exposure to steam and the better results obtained by arranging the plates in rows.

TABLE F.

(*See Notes below.*)

Exposure to Steam	Plates	
	Piles	Rows
6 minutes	No (1)	No (1)
8 minutes	No (1)	Yes (1)
10 minutes	No (2) Yes (1)	Yes (3)

Notes.—(1) "Yes" = Successful experiment.
(2) "No" = Unsuccessful experiment.
(3) Figure in brackets shows the number of times the experiment carried out.

The second group of experiments with "downward displacement" disinfection consisted of two sub-groups:—

(*a*) These experiments were entirely successful. The following arrangements were made: (1) The plates were arranged in rows on their edges. (2) The mugs were arranged as diversely as possible. (3) The wooden box carried a full load. (4) Steam was allowed to pass until it escaped freely at the exit and thereafter for one minute and two minutes.

(*b*) These experiments were designed to determine whether "downward displacement" disinfection was applicable to plates in piles. It was found that out of eight threads on the plates at the bottom of the piles six threads were not freed from the test organisms and that inversion of the plates did not affect the results. The free air in the box was displaced by steam, but the air enclosed between plates at the bottom of the piles could not have been displaced or disinfection would have occurred. An "air-lock" is probably produced between plates in very close apposition at the bottom of a pile, and no doubt is accentuated by the weight of the superimposed plates. The eight threads at the top of the piles were all freed from the test organisms—here the plates bearing the threads had only the weight of one plate on them.

A second possible explanation of the failures in some experiments may lie in the fact that the box was not fully loaded when the plates were arranged in piles.

It was found possible to accommodate only 4 piles of plates (of 10 inches diameter) in the box—the floor of which measured 30 inches long by 19 inches wide. Had the box been 1 inch wider, it would have taken 6 piles of plates, but as it was a considerable amount of air space was left around the piles of plates. By calculation the amount of unoccupied air space was two-fifths (approximately) of the volume of the box. We may consider the box, then, to be occupied by (*a*) piles of plates with a little air between the plates, and (*b*) air, which may be visualized as columns of air parallel to the piles of plate alongside. The physical action of steam in "downward displacement" disinfection may now be recalled to mind. The steam, entering at the top of the box and being lighter than air, collects beneath the lid, and as more steam is added it descends layer by layer, displacing downwards the air which is pushed out at the exit at the bottom of the box. When the steam, having displaced the air in immediate contact with a plate, comes itself in contact with the plate it is at once condensed because of the fall of temperature produced by the coldness of the plate. In condensation, the steam contracts to $\frac{1}{1689}$ part of its former volume and the surrounding steam rushes into the vacuum so produced.

During condensation, also, the steam transfers its latent heat to the plate, and the process of condensation is repeated until the surface of the plate attains the same temperature as the steam.

If, now, we consider the steam descending layer by layer throughout a pile of plates, it is seen that these processes of displacing air and raising the temperature of the plates take up time—most of which is taken up by the condensation and replacement of successive volumes of steam in contact with the plates. The descent of the steam through a column of air without plates is not retarded by the process of condensation, and it is therefore possible for the steam descending through these air spaces to reach the exit of the box before the lowest plates in an adjoining pile have been heated to the same temperature as the steam. Under these circumstances the appearance of steam at the exit is no criterion of the temperature reached amongst the articles in the box.

Thompson[1] has recently described the successful disinfection by downward displacement of steam of inverted plates in piles of thirty-five to forty; the plates were contained in a five-gallon oil drum which apparently surrounded the plates closely.

Conclusions.

It is possible to free plates and mugs from non-sporing organisms by downward displacement steam disinfection.

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[1] "'Saliva-Borne' Disease Control—Crockery Disinfection," by Major T. O. Thompson, R.A.M.C., JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, February, 1932.

The apparatus may be of the simplest—a box temporarily connected with rubber tubing to the Warren apparatus was successfully used.

The arrangement of the crockery is important; plates should be in rows on their edges; mugs arranged diversely were disinfected, but are best inverted.

Where the crockery is insufficient in amount to fill the box, it should be arranged in layers extending across the length and width of the box, so that no large channels exist to permit the downward descent of the steam without first making contact with the crockery.

A box to hold 200 plates and 100 mugs would probably be of suitable size.

Disinfection of Plates and Cups in a Richmond Cooking Apparatus.

The Richmond Apparatus used for the experiments was similar to that described in the " Manual of Military Cooking and Dietary, 1924," pp. 14-15, and figured in schedule L of the same manual. The steam-chamber portion of the apparatus consists of two separate chambers. Each chamber has an

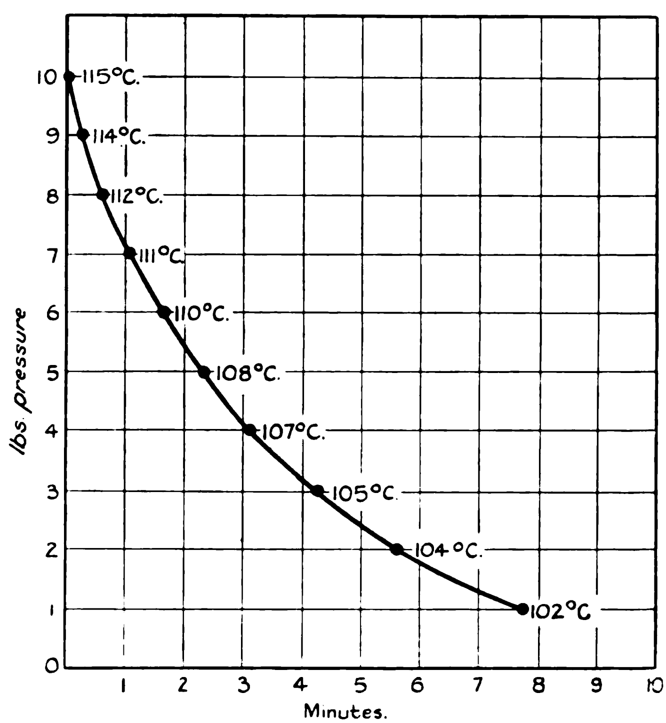

Fig. 2.—Showing average falls of pressure and temperature of steam, during the disinfection process (Richmond apparatus).

upper and lower steam-tight door and is filled with removable shelves—six in each chamber—on which trays, containing the articles of food to be cooked, are placed. Steam is admitted to the chamber by means of a

vertical pipe running from top to bottom inside the chamber on the back wall. The pipe is perforated at intervals to allow the egress of steam into the chamber and finally pierces the floor of the chamber to end in a condenser. There is no downward displacement of air by the steam which enters the chamber horizontally at various levels through the perforations in the pipe.

A steam pressure gauge, fitted to the boiler, registers from 1 to 10 lbs., above which pressure a valve operates and steam escapes. On turning the steam from the boiler to the steam pipe and chamber the pressure falls and the fall is registered by the gauge. Since the cooking chamber is directly connected with the boiler, when the steam is turned on the pressure in both is rapidly equalised. In the experiments the initial pressure shown on the gauge before allowing steam to pass into the chamber was noted, as also were the periods of time during which the pressure fell pound by pound until each experiment was ended.

Capacity of the Apparatus to hold Crockery.

The cubic capacity of each chamber is 7·4 cubic feet (approx).

Plates may be piled directly on to the floor of the chamber or on shelves inserted where required. In each lower compartment two piles of 51 plates were placed, and in each upper compartment two piles of 43 plates, i.e., 188 in each chamber, or 376 in the whole apparatus.

Plates may also be arranged obliquely on their sides in the potato steaming trays. It was found possible to accommodate 19-20 plates in each tray, when two trays were used, one in the upper and one in the lower compartment. On testing the capacity of the apparatus to take the trays with plates lying obliquely it was found possible only to accommodate in the bottom compartment three trays of 15 plates each, and in the top compartment three trays of 13 plates each, i.e., 84 plates in each chamber, or 168 in the whole apparatus. Breakfast cups holding approximately 8 ounces each were arranged on their sides in the perforated trays used for steaming potatoes. Each of five trays accommodated 3 rows of 6 cups, whilst, owing to an extra amount of overhead room, the sixth tray held in addition 2 rows of 6 cups lying on the 3 rows. Total number of cups in each chamber was 120, or 240 in the whole apparatus.

It was found that 32 pounds of coal were required to light the fire and raise the pressure to 10 pounds; this would not normally be charged against the disinfection of crockery as the steam would have been raised already. Subsequent steaming was found to require 10 pounds of coal per hour.

Twelve experiments in the disinfection of plates in the Richmond apparatus were carried out.

In half the experiments the plates were arranged in piles, whilst in the other half they were arranged obliquely on edge in rows. The better results obtained by the latter arrangement is shown in Table G, which gives the numbers of threads freed from the test organism under comparable conditions.

TABLE G.

Duration of Exposure to Steam	Initial Pressure 10 lbs.	
	Plates in Piles	Plates on Edge
5 minutes ..	0 freed out of 6 = 0 per cent freed	6 freed out of 6 = 100 per cent freed
8 minutes ..	3 freed out of 8 = 37·5 per cent freed	3 freed out of 3 = 100 per cent freed
10 minutes ..	5 freed out of 6 = 83 per cent freed	3 freed out of 3 = 100 per cent freed
TOTAL ..	8 freed out of 20 = 40 per cent freed	12 freed out of 12 = 100 per cent freed

Table G also shows the improvement in results with lengthening of the period of steaming when the plates were arranged in piles.

The improvement in results with the lengthening of exposure noted in Table G applied equally to the threads at the top and bottom of the piles. It would seem that "airlocks" between the plates did not exist in the present experiments or were easily broken down by the increased pressure in the Richmond apparatus.

Five experiments on the disinfection of cups in the Richmond apparatus were carried out and in all experiments the threads (eight) were freed from the test organisms.

Conclusions.

Plates and cups may be disinfected in the Richmond apparatus.

An initial pressure of ten pounds and exposure to steam for eight minutes has completely freed from the test organisms cups and plates (arranged obliquely on edge) in trays.

If full use of the capacity of the apparatus is to be made, plates should be arranged in piles; five out of six plates were freed from the test organisms with an initial pressure of ten pounds and exposure for ten minutes. It is probable that longer exposure will improve the percentage freed.

SUMMARY.

Experiments with the Warren Apparatus using Standard Fittings.

Plates and mugs as used by the troops were arranged in the E and F steaming tins, and the type of apparatus used accommodated 200 pint mugs or 324 dinner plates.

Various exposures were made with different loads, and the best results were obtained by using three tins for fifteen minutes when one hundred per cent of the threads were disinfected.

For practical purposes, if five minutes per tin are allowed, with all the tins loaded, disinfection of ninety per cent of the crockery may be expected.

This is considered a reasonable standard of cleanliness, but should it be necessary to obtain a higher standard, this may be obtained by using E tins only, with the same exposure period. When using only one tin,

however, it is recommended to allow ten minutes steaming, as some steam heat is used in warming up the tin; this loss does not effect the results when more than one tin is in use, and five minutes per tin is allowed.

It was found that twelve pounds of coal were expended in maintaining the output of steam for one and three-quarter hours.

The arrangement of the crockery in the steaming tins is important. Plates should be arranged on their edges in rows across the breadth of the tins; mugs should be inverted.

Experiments with the Richmond Apparatus using Standard Fittings.

Plates and cups as used by the troops were arranged in the steam chamber portion of the apparatus which was capable of accommodating 376 dinner plates when arranged in piles, or 168 plates arranged obliquely on their edges in trays, or 240 cups on their sides in trays.

Various exposures were made with different loads.

An initial pressure of ten pounds and exposure for ten minutes gave the best results.

Small quantities of crockery (two trays of obliquely arranged plates and cups) will be completely disinfected.

Three out of four test plates were disinfected when the plates were arranged in two piles of fifty each.

It is probable that longer exposure will be necessary when the apparatus is loaded to capacity.

It was found that ten pounds of coal were expended per hour in maintaining the output of steam.

Experiments with a Wooden Box connected to the Warren Apparatus.

An old ice chest was adapted for the "downward displacement" of air by steam and was connected by rubber tubing to a jet on the Warren apparatus.

Plates and mugs were disinfected under the following conditions: (*a*) The plates were arranged on their edges, in rows running across the breadth of the box; no gaps were left between the sides of the box and the rows nor between the rows themselves. (*b*) The mugs formed a complete layer on a grid above the plates. (*c*) The box was fully loaded. (*d*) Steam was passed into the box until such time as it had issued freely for one minute from the exit at the bottom of the box.

The ready supply of steam in unit cookhouses suggests the provision of a small "sack disinfector" to be installed outside a cook-house and connected with the cooking apparatus. This would effect savings on the cost of fuel required to start up and run the larger disinfectors, when only a small quantity of material, e.g., one man's kit, requires disinfection; in addition, in many stations considerable transport costs would be avoided.

The disinfection could be carried out under unit arrangements, supervised by the officer in medical charge of the unit.

THE PRINCIPLES OF HOSPITAL ACCOMMODATION IN THE ORGANIZATION OF MEDICAL SERVICES IN THE FIELD.

Reprinted from the *Bulletin International*, 1933, vi, 285, and Translated by Brevet Lieutenant-Colonel A. D. Stirling, D.S.O., R.A.M.C.

By Colonel SCHICKELÉ, France.

Lecture given at the Second Session of the International Office of Military Medical Documentation, Liège, June, 1932.

In a previous communication I pointed out that the organization of the Medical Service in the field depended on three essentials : sorting out, evacuation and hospital accommodation. In practice these cannot be dissociated, but in this paper I am dealing only with the question of hospitals. If evacuation is the means, hospital treatment is the object ; by it alone is it possible to ensure such permanent treatment as will bring about complete recovery. For this reason hospital organization should be brought as near perfection as possible. On service it must be adapted to the situation. The most important consideration is the accommodation required and with the many and varied forms of arms now in use it is essential to think in thousands of beds. Such a problem presents serious difficulties ; in addition to beds a moderate degree of comfort and security is essential and with the long range of modern guns this is never an easy task.

The wounded soldier is regarded as a loss to the force and the sooner he is evacuated the better it is for him and for the morale of the force. Such was the principle in the French Army in 1914 ; the results were far from satisfactory, as an important factor with an important bearing on the question of hospital treatment had been overlooked, namely the character of war wounds which demand immediate treatment if serious infection is to be avoided. As the result of this, the tendency was to group hospitals as near the front as possible, so that until 1918 treatment was carried out in the Army zone, thanks to the more or less fixed front line. Initial treatment for severe wounds had to be carried out in the Army zone and this resulted in more rapid recovery with a saving of hospital accommodation. This arrangement worked very well till 1918 when, under enemy attack, fronts previously considered safe were thrown back and excellent hospitals disappeared, one after the other, so that mass evacuation again became necessary, with, however, much improved arrangements. Careful sorting was carried out and this was continued during evacuation so that patients unfit to continue the journey were taken off for treatment on the spot.

It was proved that evacuation to the base could be carried out under

strict surgical supervision and we have thus been brought to the principle which must govern hospital treatment in the field. This is quite simple and is based on two factors:

(1) No patient must leave the Army zone without primary treatment followed by a minimum period in hospital.

(2) Hospital treatment must be arranged whenever there is a risk in further evacuation.

This danger appears early or late according to the nature of the wound; it is measured in time by the urgency of treatment and in distance by the means of transport available, thus the more perfect and rapid the means of transport, the further from the front can hospital accommodation be arranged.

The absolute interdependence of evacuation and hospital treatment is thus seen. Rapidity in transport depends not only on the speed of the vehicles but on the state of the roads and the amount of traffic. In difficult country, e.g., mountain warfare, hospitals must be arranged near the front. It will thus be seen that hospitals must be arranged at varying distances from the front, each site being determined by the special urgency of requirements and the location of medical units as indicated below:

(1) *Front area.*—(*a*) Regimental (3 battalions) aid posts: 1¼ to 2½ miles from the front. (Note: Hospital accommodation impossible.)

(*b*) Divisional medical service: 3 to 5 miles from the front. Hospital accommodation for those unfit to be moved, 1 per cent of the total casualties.

(2) *Forward area.*—(*a*) Corps medical units: 7½ to 9½ miles from the front. Hospital treatment for the more urgent, 5 per cent of the total.

(*b*) Army and advanced L. of C. medical units: 18 to 36 miles from the front. 17 per cent of the total.

(3) *The base.*—Medical units on the L. of C. or in that part of the interior in the vicinity of the Armies, 60 to 120 miles from the front, for sixty-two per cent of the total.

(4) *The interior.*—Distance is no longer of importance as the patients have already had primary treatment. The total for the cases of varying urgency is thus eighty-five per cent; no account has been taken of the fifteen per cent likely to recover who may be treated in the front area or at the base according as the military situation demands.

It is thus seen that the different zones of hospital treatment have nothing like the same importance, as the proportion of evacuated cases to be retained at a given level varies from one per cent to seventy-seven per cent. It is evident that the main hospital area must be near the base, and it will thus be necessary to organize at this level a vast hospital group which can accommodate between two-thirds and three-fourths of the cases evacuated from the front. This hospital area will act as a huge barrage for the Army, ensuring that no patients from the front can be sent to the interior without having received suitable treatment, and also that cases likely to recover are

retained and sent back to the front as early as possible. In the majority of cases, therefore, this area will be situated from 90 to 120 miles from the front.

Nearer the front accommodation will be limited to that required for urgent cases which cannot be evacuated.

Such is the general organization of hospitals adopted by the French Medical Service as the result of experience gained in the Great War. Its advantages are certain, as it places professional treatment first whilst adapting it to the necessities of war. It ensures the clearing of the front area without adversely affecting the wounded by hasty and dangerous evacuation to a distance; it allows treatment to be carried out in ideal conditions of full security.

We must now consider how this hospital system can be developed; it is a question of personnel and equipment. The question of personnel does not present special difficulty and need not be considered here. Mobilization should provide all the personnel required. This does not mean that there will always be a sufficient number of trained personnel for all the varied requirements. War creates a veritable epidemic of wounds and gas cases which are not met with in peace time, and at the beginning a sufficient number of specialists is generally not obtainable.

As to equipment, there are two essentials to be arranged for in peace time—tents and shelters and hospital beds. To obtain beds is a question of requisition and manufacture, but account must be taken of the supply available in a given time so as to be ready for the first cases from the initial battles. This problem is not easy of solution at the beginning, but with time the matter presents no difficulty. Even during hostilities the rapid provision of beds for mobile hospital units demands reserves and adequate means of transport which must be pre-arranged. To have the beds is all very well, but to make use of them some form of shelter is essential. From experience the best form of shelter is one of solid construction and the best is one that has been specially built for the treatment of patients. Under this heading come hospitals, hospices, mental hospitals, clinics and private mental hospitals. It is natural that the medical service should consider systematically the use of such buildings for the particular requirements of sick and wounded in war.

In such conditions the use of existing military hospitals is quite a normal procedure.

In dealing with civil hospitals several difficulties are met with.

(1) The civil requirements of these hospitals do not disappear in war time, and reserves must be made for the civil population which must certainly increase with the risks of air attacks.

(2) Very often these establishments are in thickly populated areas which render security difficult.

(3) Except in the case of large towns the accommodation is rarely sufficient for the numbers to be dealt with.

It is thus essential, in addition to such establishments, to arrange on mobilization important new hospital equipment which can be used in large buildings built for other purposes. Such an arrangement, though at times satisfactory, generally leaves much to be desired. Among such buildings barracks are most useful; they can readily be adapted to hospital use, owing to the grouping of buildings which are usually of large size, often built on the outskirts of a town on good ground, with open spaces, good roads, water supply and conservancy arrangements.

Large schools, especially boarding schools, will make good hospitals, but they have often the inconvenience of being right in the heart of a town and lacking space around them.

Convents and other religious houses sometimes offer good facilities when isolated and sufficiently large.

On the other hand, it is seldom that commercial and industrial establishments can be suitably used.

There remains the consideration of the use of large hotels as hospitals as was frequently done during the Great War. Their use for this purpose is invariably very difficult, especially in hotels *de luxe*. The numerous small rooms make heavy work for the personnel, who incidentally require more supervision. Thus large hotels are not very suitable except when employed for special purposes as annexes to other hospitals, e.g., for officers or infectious cases.

In general, and in view of the great improvement of the hospital service, a long view must be taken. In modern war everything is industrialized, the medical service included; it is necessary therefore in this technical service to seek the rational organization of work. In large establishments the best means of securing economy of labour is by specialization and by the association of various services which alone ensure the maximum efficiency from the industrial point of view.

This consideration, of which it is impossible to misunderstand the importance, brings as a direct consequence the insufficiency, which will often be found, of existing accommodation for the whole of the beds essential for the purpose. For this there is but one remedy—to construct. One may first of all enlarge existing places which are suitable but too small. In this way one can have a nucleus with the essential services of a hospital. When this is insufficient it will be necessary to resort to complete construction of hospital establishments.

The French Medical Service had during the war to construct very large hospitals of several thousand beds; all the other belligerents had doubtless to do the same.

Experience shows that such schemes demand material, labour, much time and great expense; of these factors one only is important, that of time. To establish a hospital of several thousand beds it is by months that one must reckon, and the question arises as to whether the military situation will permit of such delay. The stabilization of the war of 1914-18 is apt

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to give a false impression with regard to this ; what was then done will be quite impossible in war of movement.

From evidence available future hostilities must normally begin with a period of great activity ; it is a necessity if the belligerents wish to avoid stabilization which leads to exhaustion of the forces in the field. But, on the other hand, modern technique brings with motor transport new possibilities which must modify tactics profoundly. It is not rash to visualize, thanks to these new methods, operations of great extent in which armies could be thrown rapidly into active operations from their base. The preparatory phase of the battle may then be very short, which prevents any prior establishment of important medical units. One must therefore rely on the light shelters with mobile hospital units, and the use of tents is the only practical means of increasing the accommodation. In such conditions one must visualize that hospital accommodation in the Army area will be limited more and more to cases of the greatest urgency, and that one will have hospital bases in the rear linked up by an efficient system of evacuation. These bases must be prepared beforehand, which entails the systematic investigation of all local resources which can be used by the medical service. It is in such places that the mobile field units will be installed, to ensure the fulfilment of the hospital mission with which they are entrusted, and they must of necessity be somewhat primitive. In what conditions of security are these medical units to function, utilizing to the full hospital resources in crowded areas.

The Geneva Convention with its precise stipulations on the protection of field medical units made one believe that the problem had been solved. It was so indeed, before the introduction of long range guns and aerial bombardment ; but it is no longer and will become less and less so with the increasing development of new war methods. Thus protection for these units can only be secured by isolation, but I think it has been shown that at the beginning of a campaign and during the whole period of intensive military operations the isolation of our large hospital units will be practically impossible. To meet such a situation, which is difficult to avoid, we have two alternatives : either to renounce the protection of the Geneva Convention or to admit right away that the protection can no longer operate when the military conditions are not favourable. These alternatives are regrettable. They represent a grave retrogression for the Geneva Convention as one of the international measures which do honour to humanity. But should not we, military medical officers, consider ourselves the faithful and vigilant guardians of this Convention ?

Our presence in this international union shows that our status as soldiers belonging to a national army does not forbid our thinking of anything which can bring a little pity, a little relief of suffering to our sick and wounded. It appears that the Geneva Convention is to prove incapable of protecting our patients. Must we accept this situation ? I know your answer. Then it is for us to see how the situation may be met.

On this subject I venture an opinion which may serve as a basis for future discussion. As security can only be secured by isolation, the grouping of hospitals in localities of varying importance according to the area under consideration must be carried out. There will be a sort of hospital town or village entirely reserved for the particular requirements of the medical service with the definite exclusion of all purely military activities. These localities will be clearly marked by the conventional sign on the ground, and it will be rigorously forbidden to carry out any hostile act against such places. Notification of such areas could be made between belligerents either directly or through the International Red Cross Committee.

The objection to this system is clear. What guarantee will there be of the strict use of these areas for hospital purposes? Without doubt an unscrupulous belligerent might be strongly tempted to camouflage military organizations by the Red Cross. It is easy to prevent this.

During the Great War, following the torpedoing of hospital ships, an agreement between the belligerents provided for the presence on board ship of a neutral commission whose duty was to ensure that the ship was not used for any but medical purposes.

There is no reason why a similar measure should not be adopted for hospital areas. A neutral commissioner nominated by the permanent International Red Cross Committee or approved by them could be arranged for. Thus every adversary could be certain of a loyal and correct application of the Convention, which would take away any pretext for committing a hostile act against a hospital centre.

With the prospect of wholesale war in which, under massive air attacks, combatants and non-combatants will be confused without distinction of age, sex, profession or state of health, the institution of such places of refuge which cannot be attacked is absolutely necessary. To forego this would be like a return to the horrors of barbarism, to a war of annihilation. One shudders to think that such an eventuality could arise in our advanced age of civilization. Médecin Général Saint Paul, under the *nom de plume* of Espée de Metz, has already raised the alarm in demanding for women and children, aged and infirm, places of refuge which he names "lieux de Genève." We must also ask for similar safeguards for the sick and wounded. Nothing is more cruel in our eyes than the lamentable spectacle of a wounded man being murdered on his bed of pain, and we must do everything we can to render it impossible.

You would no doubt like to know now whether means of estimating the number of hospital beds required exist. Obviously to such a problem the answer must be in the nature of a close approximation without mathematical accuracy. Generally one can never have too many beds, and it is often necessary to have too many to be certain of having enough; but all the same is it necessary to have a thousand or ten thousand beds for a given situation? It is important to know this.

First it is necessary to know the probable losses in a given battle. Experience gives us some information on this subject. The modern battle consists in general of a series of successive efforts in space and time of which the average duration is four days. The total losses for these four days can be estimated by the following rule: 1st day, 3; 2nd day, 3; 3rd day, 1; 4th day, 1. Total, 8.

The proportion of killed is five per cent of the total losses. According to the nature of the fighting losses will be heavy, moderate or slight.

In the last war the French infantry division with effectives of 15,000 men, of which two-thirds were infantry, lost 4,000 men in four days; of these 1,600 were wounded or gassed and 400 killed. This refers to an engagement in which severe losses occurred.

We may deduce from this that to meet the losses of an engagement a number of beds at least equal to the figure of sick and wounded and gassed is necessary, with additional beds for unforeseen circumstances. The number 1,600 multiplied by the number of divisions engaged with ten per cent additional gives a working basis.

There is another method which consists of calculating on the losses of the first day. These must be known in order to calculate the number of vehicles for evacuation or the number of surgeons indispensable for the initial treatment of the wounded in the first twenty-four hours. Let us see what these figures give.

Referring to the table of losses each day, we see it corresponds to three-eighths of the total losses, or 37·5 per cent. Personally, I consider that the hospital beds required for an engagement are equal to three times the losses on the first day. This means multiply 37·5 by 3, which gives the figure 112·5, which is the sum of the total losses plus 12·5 per cent, or, if you prefer it, increased by one-eighth, which gives a coefficient of sufficient security.

For the division of beds between front and rear areas, let us take the number of hospital beds in the various zones: Army Corps, 5 per cent; advanced Army area, 17 per cent; and slight cases likely to return to the front, 15 per cent. This gives a total of 37 per cent, and at the base, 62 per cent. As we know that the losses of the first day are 37·5 per cent of the total, we conclude that in a total of beds equal to three times the losses of the first day, we must have in the front area beds equal to the losses of the first day and at the base twice this number.

If this method of calculation is simple, it has no pretension to being mathematically accurate, and the results must be adapted to the circumstances of the moment. All the same, it is interesting to know that an army of 10 divisions runs the risk of having on the first day of battle 6,000 wounded or gassed, and requires 18,000 beds, that is, 6,000 in the front area and 12,000 at the base.

Here are certain other figures with regard to hospitals which are of interest.

For each bed in an equipped building you must reckon : 55 square yards of space, 6½ to 8½ gallons of water, over 1 yard of water pipe, over one yard of track, over one yard of road, 10 watts of electrical energy.

In the division of beds, for each general surgical bed it is necessary to reckon : ½ a medical bed, ¼ a bed for special medical cases, ¼ a bed for special surgical cases.

Once again let me say that it would be quite wrong to consider these figures as absolute, but they are useful for a rapid appreciation of the complete building requirements for a war hospital. We can thus estimate that for 1,000 beds we must have 12·3 acres of ground, 1,980 gallons of drinking water, 0·62 miles of water piping, 0·62 miles of track, 0·62 miles of road, 10 kilowatts of electrical energy, corresponding to 13·5 h.p.

The mere mention of these figures enables one to understand the reason why such establishments require for their completion weeks and months, and demand the opening of a veritable timber yard, which only specialists can manage.

The conclusion is reached that the problem of hospital provision on the scale of losses as calculated presents great difficulties. Far from getting less these tend to become increasingly greater with the menace of aircraft on important cities. If this threat is realized—and circumstances do not allow us to hope that it may not be—the difficulties will become formidable owing to the increase of hospital beds necessary for the civil victims of war and to the risks run by our hospitals which are not properly isolated so as to be immune from air attacks, unless the principle of hospital areas is adopted.

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ON AND ABOUT KAMET—1913.

By Major C. H. H. HAROLD, O.B.E.
Royal Army Medical Corps.

(*Continued from p.* 448, *vol. lxi.*)

The March Continues.

We continued our march via Nandaprayag, Chanoli, Pipalkoti, occupying Government rest houses *en route*, the use of which was restricted to Europeans in possession of the necessary permit, and Government servants. At one of these we were met by a hillman who begged us to come to his village to shoot a cheetah which had killed his best buffalo.

We visited the kill in a nullah and found the animal had been dead some forty-eight hours, and that the panther had been seen since. That night, tying up a goat, we sat up in two parties alongside the kill. The panther did not appear, although the naik maintained that a slight noise heard was the panther, which he clearly saw. As these men have such wonderful vision he was probably correct.

As we continued on our way we began to learn more of each other. The Gurkhas, who chatted and commented on every conceivable thing, were a great source of interest, and when I was unable to follow the trend of their remarks, or failed to make myself understood, I appealed to Todd. On one occasion when the havildar was cleaning my gun I noticed that he wore the chotee or small tuft of hair by means of which when they die they are carried straight to heaven. It struck me as curious that a Gurkha with his Mongolian type of face wore this in common with the Hindoo, as a religious observance, whereas amongst the Chinese, whose facial characteristics are similar, the pigtail is regarded as a mark of inferiority imposed by their Manchu conquerors. Seeing that the havildar had been in these parts before, I tried to find out what his views were on the places and people we met. He stated that the general belief was that the Badrinath image had come down straight from heaven in a flame, and by its fall the Holy place of Badrinath had been defined, and boiling water had rushed out of the ground to meet it. Whether the image or part of it is meteoric in origin I do not know. Furthermore, certain of the pilgrims were housed in special houses warmed with earthenware pipes containing hot water derived from underground sources, and that fires were unnecessary since eggs could be boiled and rice cooked by its agency. He also stated that all pilgrims were fed by the Rawal Sahib. I had not the opportunity of verifying the truth of all these statements.

A Hill Test.

Another day when we were held up, Todd, who was now fit, suggested that after lunch we should both take rifles and climb a hill which looked

down over the valley above the Rest House. The hill was bisected by a small glacier-like formation which was snow covered above and fed a small stream below, which, tumbling some hundreds of feet over a precipice, flowed away at the base of the hill. This was agreed, and, after an early tiffin, we tossed for sides. I took the side covered on its lower slopes by forest growth, and Todd the open side. It was thought that bear might be found on my side and bharhal on the other, and we arranged to meet at the top. The havildar was told off to accompany me, and the naik, Todd. On the way up, as we passed through dense growth including giant rhododendron, we saw traces of bear. The havildar concluded that these coming out of their winter's sleep were moving fast and far, and if we intended to reach the top we must press on. Passing through a belt of small bamboos we reached open ground and then pushed on to the summit; when we arrived there we could see no sign of Todd. Below, our progress had been impeded by undergrowth, and we reached the top just as the sun was sinking. The scenery was gorgeous, but the winds off the snows blew fresh and keen. To this we were extremely susceptible, being clothed for a warm afternoon's jaunt in shirt and shorts. As we had grave doubts as to the possibility of reaching camp before dark, it was decided that we would have to put our best foot forward and so we started down at the double. The air grew colder and colder as darkness came on. At length, as we were making poor progress fighting our way through the undergrowth in the failing light, we decided to follow the scarred watercourse which showed up better. For a time all went well, the havildar sapling in hand and my rifle slung on his back, and I with an ice axe which was proving most useful. In the course of our descent it became necessary to negotiate a few awkward bits of projecting rock, with a sheer drop into the watercourse below, and finally we came to a chimney, which in this half light looked particularly grim, but it was our only means of descent and we could not turn back. I now found that the nails in my boots from Cawnpore were set too far in and I could not obtain a proper foothold. The havildar, as was his custom, had removed his boots. With chilled fingers and hampered by my ice axe, on three different occasions I slipped off the rock face, and each time my companion, by sheer muscular strength, held me firmly against the cliffs until I could regain a footing. These were anxious moments indeed, since a fall in any of the places would have resulted in my being broken up on the masses of rock below. Night had now descended upon us, as it so quickly does in these parts, and we were completely benumbed by severe bruises caused by falling into pot-holes hidden between rocks and being drenched by icy water.

We were forced to leave the watercourse and skirt the edge of the forest. By this time the havildar's toes and fingers were torn and bleeding, and his condition was so bad that he could walk only with difficulty.

At last we came upon a smooth slate surface, and for a time we managed to progress fairly easily aided by dwarf bamboo stems growing

out of fissures in the rock. These we grasped in passing and so checked our descent. The havildar, sapling in hand, felt for these patches in the gloom, and thus we moved down the hillside from group to group.

It was now quite dark and the incline more vertical, we could only continue our descent by the havildar adopting a sitting posture after locating a clump below and sliding down to it. Steadying himself by grasping the bamboo stems, he called "Tik hai, sahib," and I then slid to him. He countered the force of my impact by his grasp on the shrubs until I could get a firm grip of the same clump. For a time things were looking more cheerful, but soon the sounds of running water became more noticeable, a rising spray was borne over us by the breeze, and finally the havildar, after vainly feeling about with his stick and meeting nothing, said, "Cutch nehai, sahib."

We now knew we were at the edge of the precipice, and grasping the stems of the bamboos we leaned against each other. Clothed in shirts and shorts we were almost too cold to think. Our limbs were numbed, hams excoriated, and through the holes in the seats of our shorts the rock struck cold. Smoke we could not, since the cigarettes and matches in my breast pocket were pulped and drenched with water. We attempted to shout, but this proved useless against the noise of the waterfall. Finally we lapsed into silence and huddled against each other for comfort. We both realized, without speech, what the chances of rescue were, and what a night's exposure under these conditions meant. The question was—When would it be, and what form would it take?

I spoke to the havildar and he did not answer. I spoke again. No reply. He had completely ceased to cerebrate.

As we sat, an idea formed. "Hamara rifle, havildar," I said. Withdrawing the safety catch I fired in the direction of the camp, hoping that if the sound of the report were drowned by the noise of the waterfall, the whistle of the bullet might attract attention. We waited, I fired again.

After what seemed an age, a tiny pin-point of light appeared in the valley below, then another, and I said to the havildar, "Thank God, they have heard." I felt in my shirt breast pocket for clips of other rounds and knew we would have enough for signalling purposes. Following this was a period of mental detachment and remoteness attributable to extreme cold, and after what seemed years we saw about a dozen lights coming up the hillside. I continued to fire at irregular intervals, and at length lights and figures appeared above us to our flank, and we could hear their answering shouts. Very shortly hillmen with ropes and torches of oil-impregnated rope descended upon us, and we were half carried and pulled up on to a shelf where the torrent descended as a waterfall over the face of the precipice. Never before had the smell of unwashed hillman with clothing reeking of sweat and wood smoke, appeared less obnoxious, nay, shall we say, absolutely sweet.

The shepherds led us across stream by a line of rocks and on to the

hillside where we met Todd, who was quite overwrought. "Fools, idiots, etc.," did we not realize how far it was, and, that it was a leg pull. The havildar replied, "Hookum, sahib," but I was too done to speak or worry and as I remained silent Tood passed his hand over me, to find that I was wet through and icy cold. Putting his tweed coat over me, he next poured half a flask of neat pre-War spirit down my throat, and then passed it to the naik, telling him to give it to the havildar.

From now onwards I was so drunk with spirit, cold and fatigue, that I could not walk, and Todd and another helped me down the rest of the hill and so into the bungalow. Dinner had been kept and a bath was ready. It was after midnight, and as I could not face the former, fell into a boiling hot bath, and put on my pyjamas. I asked for tea and a little whisky, this being our customary reviver when really done in after a double march. Taken about an hour before a meal this stimulant is a marvellous restorative and assists the most exhausted to face food.

I now managed to eat something, and being overcome by weariness and whisky, made for my bed. Awaking late next morning to find Todd by my side, my attempts at movement called forth hearty curses, I being one big bruise from my toes to my thyroid. Still, it was something to be capable of feeling. Asking my bearer for a hot bath, I breakfasted as I lay, and later went out with some dressings to see the havildar. I found that his feet were so torn and bruised that he could not wear boots.

Whilst treating the havildar's feet and congratulating each other on our good luck, the chapprassi arrived in high feather, feeling that last night's round up of the hillmen compensated for his lack of success in respect of coolies. Joining in the conversation with an ingratiating smile, he pointed up the hillside at the precipice. "Dekko, sahib." This was too much for me. I felt as if a heavy forward had put his foot into my solar plexus. As for the havildar, he turned green, and moving to one side discarded his early morning meal!

Thus ended the hill test, one result being that our treasure chest was depleted of many a good rupee, and the other that since those days I have always pressed for the adoption of laced tea in lieu of cold spirits as the normal emergency ration, first in East Persia, and afterwards in Northern Command, India and the Southern Command at home.

Plan for the Attack on Kamet.

It appeared that whilst I had been otherwise engaged, as coolies were not forthcoming, Todd had written to the Rawal Sahib at Badrinath to invoke his aid, and had also sent to Joshimath for mail. When the latter arrived he learned that Slingsby was now in position at his base camp and was anxiously awaiting our arrival. The weather and snow conditions were perfect and if Todd did not arrive soon he proposed making an attempt without him, as these climatic conditions were due to break at any time now, also he had only a limited time before the expiration of his

leave. When the coolies eventually put in an appearance, we double-marched through Gulabkota and arrived at Joshimath next day. As can be understood, these repeated delays caused Todd to be well-nigh frantic with anxiety, and, owing to the fraying of his temper, he was prone to explosive outbursts on the smallest provocation. He spent the whole time when in camp poring over maps, whilst I interviewed the cook, took the daily messing account, etc.

I learned that the plan agreed upon by the two climbers was to be on Kamet at the end of what they called the "chota bursat" (small monsoon), and in the interval between this and the main monsoon precipitation, termed the "burra bursat," a period usually occurred during which the weather conditions were ideal for climbing since the freshly fallen snow was not too deep, was reasonably firm, and had not as yet consolidated into ice, and this, the optimum time for the proposed attack, was now at hand.

I gathered that there was a divergence of opinion between Slingsby and Todd regarding the best route from which an attack on Kamet should be launched. Slingsby proposed making an attempt from Ghastoli on the west, which was his base during his previous attempt in 1911, whereas Todd, basing his opinions on Bruce and Longstaff's surveys, considered that a less arduous route might be found on the eastern side. The present arrangement was that each climber should make a simultaneous ascent from his selected base and trust to meet on the slopes above. Should both fail, then a concerted attack would be made along some route that, later, might appear to offer the best possibilities of success.

A certain amount of regimental rivalry entered into the first scheme, since Todd was backing his efforts, seconded by Gurkhas, and Slingsby depended upon trans-frontier Pathans of his regiment.

Incidentally, both were fired with an ambition to regain the altitude record which the Duke of Abruzzi had recently wrested from Dr. Longstaff.

Furthermore, Slingsby mentioned in his letter that a noted Alpinist, Meade, with an Alpine guide, Pierre Blanc, was at that time also attempting an ascent from the north-east, and Todd was particularly anxious to have the eastern field to himself. This state of affairs added fuel to Todd's irritation. As we marched, he inveighed against the intrusion of civilians into India and the professionalization of climbing by the introduction of paid guides. All of which in his normal moments he would have scouted as puerile in the extreme.

On this march I noticed a mere child carrying the suitcase containing the cash box. The day was hot and his face was bedewed with sweat. At the end of the first parow I pressed the chapprassi for his exchange, but the boy begged to remain, lest he, a hill-boy, should be shamed before his household and reckoned a weakling. At the pay-out I suggested extra backsheesh, but this was vetoed by Todd, who pointed out that if this were

allowed we would find a predominance of children carrying our loads in future.

In due course we reached Joshimath at the junction of the Badrinath and Niti paths, which follow the courses of the Alaknanda and Dauliganga Rivers. Joshimath is the headquarters of the High Priest of Badrinath during the winter when the upper valleys are blocked and snow bound. Here, we interviewed the two most important officials, i.e., the postmaster, and the civil surgeon (sub-assistant surgeon) in charge of the dispensary. We visited the hospital and both officials promised to keep us well posted and do all they could to assist. Here our cook baked a new supply of bread and we laid in a stock of potatoes and fresh supplies. We now turned off the pilgrim route, bore to the east along the Dauliganga in the direction of the Niti valley, and here the whole beauty of the snows was disclosed to our wondering gaze. Whilst Todd pointed out the giants Trisul, Nanda Devi and Dunagiri, the havildar was making a running commentary to the naik on the country around, and stated that the best heads were to be found on the bharhal feeding-grounds running up to Dunagiri. Our next stage was Tapoban, where the information followed us from Joshimath, probably tapped down by telegraph, that Slingsby was making his attempt, and Todd's anxiety was intensified. We now met a hill coolie in a complete suit of warm clothing supplied by Meade, who in loud tones told our coolies that Meade paid all stage coolies a rupee a head per stage. At this, the vials of wrath were released, and Todd ascribed all our troubles with the coolies to globe trotters spoiling the market and ruining India for the poor soldier.

From now onwards everything was hurried and the fever of the next few days left me in a haze which has rather clouded my memory. We next marched to Suraitota, through Jumagwar, and on to Malari. Here a special runner arrived with the news that Slingsby was dead or dying on the snows, but that the Rawal Sahib had sent a relief party for him.

All was confusion. Todd got out the maps, the havildar and local hillmen were questioned, and I was informed that Longstaff had found a route across the Zaskar Range, and we were going to cross to Badrinath by it. The following morning we changed our direction, left the Niti route and turned up the mountain side. Up and up we went over rocks in tumbled confusion, and the going was evil in the extreme. To add to our troubles the wind was squally, bitterly cold, and it was trying to snow. Nothing was said during the march as each was too preoccupied with his own thoughts, but Todd and the havildar seemed satisfied that we were on the right route. We went into camp, the details of which I have forgotten as we were all dog-tired, and the evening meal was much below par.

(To be continued.)

DOWN SOUTH.

BY U. P. A.

(*Continued from p. 366, vol. lxi.*)

V.—THE RETURN.

The *Chakdina* dropped her moorings and glided slowly towards the harbour heads. An array of shipping as variegated as one might expect to find in a nautical museum was passed in review. The flagship of the East Indies Squadron, a towering Orient luxury liner, a dingy tramp loading copra for Hamburg, and another discharging iron girders from Hull, a Goanese schooner with sails like a patchwork quilt, a trim little cutter flying the burgee of the Ceylon Y. C., and graceful dhows, swift launches, scarred fishing boats and small craft of every shape and description composed a picture brimfull of colour and liveliness.

Outside, a gentle breeze ruffled a turquoise sea. The crests of the wavelets, kissed by the sun, reflected back a thousand silvery smiles. To leeward, the long, low fringe of the western coast merged into its liquid cradle below and blended with the overhanging haze above, as if it were but a soft study in pastel.

Gradually the sun sank until, as it neared the horizon line, it turned from pink to fiery, coppery red, and went down with a swiftness to be counted in seconds. Then, from out the Indian Ocean arose great billowing masses of cumuli, their bosoms in grey shadow, their edges aflame. Beyond them, in infinite space, the sky blazed in a riot of red, orange and gold. Presently the transformation progressed through a wondrous range of greens and blues, until the purple pall of night, glittering with a myriad stars, enfolded the universe in a sleepy embrace.

Over the starboard quarter the lighthouse at Colombo sent its friendly messages in our wake, but even its powerful beam seemed somnolently lazy in the velvet night.

The wind dropped. At once the air became humid and hot. Away and away beyond the contours of the clouds, sheet lightning illumined the distant sky, and the deep, muffled rumble of thunder echoed over the surface of the waters. Occasionally, a nearer flash, followed by a more sharply defined roar, startled the senses into a keener perception of Nature's restless imminence.

Forward in the darkness, the look-out answered a hail from the bridge and the bell sounded the end of the second dog-watch.

We went below to prepare for dinner but, although the cabin was spacious and airy, it felt insufferably oppressive. We were the only passengers aboard and we dined with the captain and chief engineer, the

former a courteous, capable looking Devonian, the latter a cheerful, pawky Clydesider.

Have you ever noticed how a shipping line stamps the attitude and bearing of its officers with its own special mark? Perhaps this is not to be wondered at, since it is common knowledge to us that, in our own little sphere, certain queer folk such as sappers, highlanders, riflemen, etc., possess characteristic peculiarities which distinguish them from the common herd. So, on board ship it is interesting to repeat the observation that a man is fashioned more by his immediate surroundings than by his general environment; it is not the sea or the Service, it is the ship or the corps which endows the individual with his more intimate and noticeable foibles and mannerism. Thus, in the officers of the P. & O. are perpetuated the semi-naval traditions of the old Blackwall frigates, in which official exactitude and strict discipline governed social as well as working hours. How different the atmosphere of the Allan and Anchor liners, in which the officers, if canny, are always kindly; or of the ships of the B.I.S.N., famous for their cheerful friendliness.

These divers types of bearing and behaviour are general and customary within the respective companies, and they are best exemplified amongst the deck officers. Engineers, whether terrestrial or marine, are usually a law unto themselves.

One day I was standing on the deck of a ship which was nearing Suez. We were overhauling a Patrick Henderson boat, homeward bound from Burma. Our third engineer, Misterr Macpherrson, grimy and perspiring, emerged from the depths in search of a breath of cool, clean air. As we neared the Henderson steamer, she sheered off.

"She doesn't seem to like us," I said.

"No, sirr. But fine I ken auld Captain Macnab; comes frae Dumbarton—same 's mysel': he believes in keepin' strangerrs at a safe distance." And, with that, Misterr Macpherrson descended into the depths. As he reached the bottom of the steel ladder, I distinctly heard him chuckle.

It was too hot and sticky for sleep in the cabin below, so we spent an uneasy night on the settees in the saloon. We were on deck at dawn. The coastline loomed through the early morning mist, and Tuticorin, lighted by the sun's first rays, presented a typically Eastern picture.

Nowhere more than in India does one realize the full force of the saying that distance lends enchantment to the view; the shorter the distance the less the enchantment.

The anchor was let go inside the long northern spit of Hare Island, four to five miles off the land. Although the bay is well sheltered, it is very shallow. Attempts have been made to dredge a deep water channel, but they have been abandoned because it has been found that the sandy bottom overlies a bed of impervious rock.

After breakfast the ship's officers gave us a hearty send off, and we went ashore in a launch. The car followed in a lighter, which was propelled by a lateen sail. This was primitive enough; but, on the quay, the crane seemed more primitive still. However, it is often the case that when things appear to be at their worst, they turn out for the best—notably in the wonderful land of Hind. The car was put ashore safe and sound.

Provided the weather is good, the sea route, Tuticorin-Colombo, is to be preferred to the road-sea-rail journey, Madura-Manaar. The former is less exacting, not so crowded and more comfortable. But in bad weather, and especially during the monsoon, the Gulf of Manaar will test all but the most seasoned sailors, and the landing may be difficult.

Tuticorin is the most southerly harbour of any size in India, and the second in importance in the Madras Presidency. It has had a chequered history. By capture, cession, or treaty, it has changed hands thus :—

1540, Portuguese; 1658. Dutch; 1782, English; 1785, Dutch; 1795, English; 1818, Dutch; 1825, English!

There is an old Dutch cemetery, with skull and cross-bones over the gateway. It contains a number of tombstones bearing elaborately carved coats of arms. The history of Tuticorin is largely made up of accounts of more or less serious squabbles botween the Dutch governors and the neighbouring British factors and collectors. Some of these accounts are amusing, and convey the impression that the British officials were expert in the art of leg-pulling, not always of a gentle kind.

For long, Tuticorin has been a Christian missionary centre. The old fathers of the Church were not devoid of a sense of humour, but he must have been a grim type of joker who named the big R.C. church "Our Lady of the Snows," particularly as Tuticorin means "The place in which the wells dry up." Water has always been a difficulty here; it has to be piped from a distance, as all the wells in the town are brackish. The surrounding country is covered with but a thin layer of soil or sand, and the vegetation is stunted and scanty. Nowadays, it is as a great cotton exporting seaport that Tuticorin is noted.

From 8.30 a.m. to 10.30 a.m. we were busily engaged clearing ourselves, Café Noir and the car through the Customs, getting away from the docks and settling with the shippers. With the last named an hour was spent in proving firstly, that the charges need only be met once; and secondly, that a receipt for payment was essential. It was an hour well spent because, three months afterwards, I was billed again, and the hardly-earned receipt proved a trump card.

Life moves in leisurely fashion in Tuticorin, and no wonder, for the climate is very trying: hot and excessively humid. By the time we got under way we were all streaming with perspiration, and our clothing clung to us in moist, warm folds—ugh! For the first thirty miles the road was hot, airless and devoid of shade. Also, the surface was so bad that our

speed was kept below 15 m.p.h. After that, conditions improved and we were soon dried and refreshed by the currents of air set up by the fast moving car.

We ate our picnic tiffin in the dâk bungalow at Koilpatti, fifty miles north of Tuticorin. This dâk bungalow is a remarkable looking old two-storey building, lofty, open to the winds—when they blow—clean and provided with good hand punkahs. Behind the bungalow is an ancient temple, the tank of which is fed by a spring welling from rock. Near by is a solitary mass of perpendicular rock which is honeycombed by ramifications of an old cave, partly natural, partly artificial, and wholly insanitary.

From this point the scenery was varied and interesting, through Sattur Virudupatti and Tirumangalam.

It was market day at Virudupatti, and the scene was charming. The centre of this small town is occupied by a fine, rock-hewn tank, and from this acquatic "square" radiate the main streets, lined with shops and crowded with country people. As all these streets were roofed with chittai matting and the roadways were well watered, the change from the heat and glare outside was as welcome as it was stimulating. I am told that, in Southern India, it is not an uncommon practice to roof the smaller towns in this way; but, for us, Virudupatti was a unique find.

Tirumangalam is noted for its dyed fabrics, and also has a reputation as a sanatorium for that common complaint in India, asthma.

By bearing slightly left at Sholavandum you avoid Madura, which is only a few miles to the east. At Kodaikanal road, about 124 miles from Tuticorin, the road forks; left to Kodaikanal, 39 miles distant, and right to Dindigul, 21 miles away.

Before taking the latter route, a word about Kodaikanal may be of use to those who would avoid the more expensive holiday centre of these parts, Ootacamund.

The first white settlers in Kodaikanal ("The Forest of Creepers") were American missionaries from Madura. In the old days sickness took heavy toll of these people, and they found that their original choice of a sanatorium—Jaffna, in Ceylon—was not a good one; so they built the first bungalow in Kodaikanal, and there their invalids have convalesced ever since.

The next bungalow was put up by Kodaikanal's grand old man, the Collector, John Blackbourne. His initial attempt to settle in the place was disastrous, for the first fire lighted in the new house reduced the building to ashes.

Kodaikanal is now a flourishing little hill station with missions, hospitals, schools and an observatory perched at a height of 7,700 feet. The climate resembles that of Ooty, but is more equable and dry. Rolling downs, woods, streams and a lovely lake provide scenery of the best kind

found in India. It is surprising to discover that the lake is an artificial one. Of the many popular beauty spots may be mentioned "Doctor's Delight," a bold, breezy bluff from which is obtained a wonderful panoramic view.

About 500 feet below the station is Shembaganur (" Magnolia Village ") where the Jesuits have an important training college for their missionary students. The course of instruction lasts for seven years.

To return to the Madura-Dindigul road: this traverses the defile through which also pass the headwaters of the Vaigai River and the S.I. Railway.

The sun was setting. The ridges, rocks and clefts of the hills to the east stood out in the golden light, while the features of the western range gradually disappeared in purple shadow till nought but their sharp, black contours could be discerned against the glowing skyline. To the north, the valley prepared for sleep under cover of the ground mist. A few belated cattle hurried on their homeward way. The goodwives were cooking the evening meal, and over each village hung a pall of pungent smoke. The day was ended.

It was dark when we arrived at Dindigul. As the dak bungalow was in urgent need of a spring cleaning, we slept in the garden—at least, we thought it was the garden. Next morning—to Georgina's momentary dismay—we found it was a public footpath.

As regards metal work, Dindigul is to the south what Aligarh is to the north; and as regards tobacco, Dindigul (*cum* Messrs. Spencer) is to India what Havana is to Cuba. However, the fame of Dindigul does not wholly rest on such mundane objects as locks and cigars, for Dindigul has a history which, by virtue of the tactical importance of the place, is a stirring one. Dindigul Fort is the key to the rich districts of Madura and Coimbatore.

This fort is built on the summit of a great rock, at a height of 1,223 feet. The rock is wedged-shaped, like a pillow lying on its side. Hence " Tindukal," or the pillow rock—also known as the rock of the demon Dindu. The fort is reached by a flight of 600 steps, and is in an excellent state of preservation.

This stronghold has been a bone of contention throughout the centuries, and records of many encounters and sieges have come down from the fifteenth century. The British first captured it from Haidar Ali, in August, 1767. "The garrison placed there then was left without provisions, money or instructions, and in the following year it surrendered to Haidar again."

A British garrison of from 800 to 900 men occupied the fort up to 1860.

On April 6, we left Dindigul and turned west, *en route* to the High Range, Travancore State.

Skirting the northern outcrops of the hills, a pleasant drive of thirty-seven miles brought us to Palni—a famous religious centre. Between 1792 and 1796 the chief of this place gave us much trouble—until he was captured and lodged in Dindigul Fort. How often do we find religion and war components of the same fiery emulsion!

Palni owes its importance to the pilgrimage temple of Subrahmanya.

Siva had two sons, Subrahmanya and Ganésa. The former used the swift peacock as his chariot; the latter, the elephant-headed, was portly, ponderous and slow. Siva offered a prize of a pomegranate to the son who should win a race round the globe. Mounted on his peacock, Subrahmanya—the first of the world's "aces"—set off at a furious pace. On seeing this, Ganésa thoughtfully scratched the back of his left ear with his hind paw, walked round his father, and claimed that, as the old gentleman was all in all, he (Ganésa) was entitled to the prize. Siva, much amused, awarded him the pomegranate.

Subrahmanya, on completing the course in less than Schneider Trophy time, was furious to find that he had been outmanœuvred by his less active but more nimble-witted brother. Even when Siva, to appease him, said, "But thou art thyself a fruit" ("palani"), Subrahmanya went off in a rage, betaking himself to the place now known as Palni, where his temple to this day stands.

At the same time it is only fair to add that, like so many other holy places in India, this temple is also venerated by the Mussulmans who claim that a very reverend faquir of theirs, one Palni Bava, is buried within its precincts.

The main temple is perched on a rock 450 feet high and commands a fine view of the Palni Hills and the rich (and exceedingly malarious) country around. Its approaches are lined by subsidiary temples and great stone images of peacocks, and of course, monkeys, live ones, are everywhere.

Faquirs, yogis, sadhus, mendicants and pilgrims crowd round the place. Milk and fish from the west coast are favourite offerings, and it is said that the latter, on this pilgrimage, will keep fresh for as long as seven days, even in the hottest weather. However, that statement is not vouched for here.

Subrahmanya's seven-day vow of silence is often observed, and is sometimes ensured by the use of a mouth lock. This lock consists of a silver wire which is threaded through both cheeks and passing across the mouth over the tongue is fastened outside in front of the lips. Sometimes a skewer is thrust through the tip of the tongue. So far as is known no statistics are available to show whether mouth locking is commoner amongst the male or the female pilgrims.

(*To be continued.*)

THE INFLUENCE OF WARS ON THE CRAFT OF SURGERY.[1]

By Surgeon Captain H. E. R. STEPHENS, O.B.E., F.R.C.S., R.N.

From time immemorial the instinct of man has led him to fight, either singly or collectively, for a multitude of reasons; and, unless human nature undergoes a very radical alteration, of which there is no evidence at present, the dream of a world at peace must remain but a dream.

A superficial glance reveals very little connection between the terrible and bloody strife of war and the beautiful, almost bloodless art practised by the surgeon of to-day. Indeed, is it possible to conceive a greater contrast between the deliberate destruction of life itself compared to the salvation or reconstruction of our maimed physical bodies in the modern operating theatre? Nevertheless, we will attempt to trace the evolution of our craft, commencing in the mythical ages, passing through medieval times to 1933. We shall then be in a position to appreciate how much of our modern surgical technique actually originated in the minds of those who laboured among the wounded in the wars of long ago. It will be proved beyond a shadow of doubt, that during the creation of our craft the most skilful surgeons were trained in naval and military circles. Not only that, but we shall see by many examples how it came to pass that the early leaders of surgical knowledge, the teachers and writers, were all recruited from those who had seen service in the field of battle. Finally, an endeavour will be made to show the tremendous influence which the last great war exerted upon the whole realm of surgery.

The idea of the title arose from a casual study of the armorial bearings of the Royal College of Surgeons of England. In these we see Machaon holding aloft in his right hand the broken arrow drawn from the side of Menelaus, brother of King Agamemnon.[2]

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[1] Reprinted from the *Proceedings* of the Royal Society of Medicine, vol. xxvi, p. 59 (United Services Section, p. 1), by permission of the Honorary Editors.

[2] Pope in his translation of Homer's Iliad describes the incident thus:—

" . . . . Machaon, to the king repair:
His wounded brother claims thy timely care;
Pierced by some Lycian or Dardanian bow,
A grief to us, a triumph to the foe.
The heavy tidings grieved the god-like man
Swift to his succour thro' the ranks he ran;
Where to the steely point the reed was joined
The shaft he drew, but left the head behind.
Straight the broad belt with gay embroidery graced
He loosed; the corselet from his breast unbraced;
Then sucked the blood, the sovereign balm infused
Which Chiron gave and Aesculapius used."

On another occasion Machaon cured the wound in the heel of Philoctetes. We may infer that the pathological lesion was a chronic sinus resulting from caries in one of the bones in the ankle due to an infective osteomyelitis. At any rate the stench arising from it was so appalling that Philoctetes was left isolated for a period of ten years in the island of Lemnos. He appears to have been a poor-spirited beast and dirty withal, or he would not have got his wound infected. However, Machaon's skill enabled him to return to duty. His duty, incidentally, consisted of tipping the arrows with his own particular variety of deadly poison. Perhaps this poison was responsible for the death of Achilles.

Thus, even in this age, we note that the leading surgeon in the land was on active service, in command of his own troops and in command of his own hospital. Hence we may conclude that Machaon, like many able surgeons, was an extremely versatile character.

Returning for a moment to the armorial bearings of our College, we see in the crest two anchors, two portcullises and the eagle—each symbolic of our three fighting services. Surely such a significant feature in the very seal of our Royal College reflects, without thought or design, the influence of wars on the craft of surgery.

We will now turn over some pages of surgical history and try to picture to ourselves the manner in which a surgeon was trained in medieval times. John Arderne [1], who may be considered the first English surgeon of repute, commenced his career in the army. During the reign of Edward III he practised those principles which he had learned in the Hundred Years War, being on the staff of John of Gaunt. Returning home after the battle of Crécy, he finally settled down at Newark on Trent in 1349, perhaps, as Sir D'Arcy Power has observed, because the ravages of the Black Death caused a temporary cessation of hostilities in France and compelled the military surgeons to seek a more peaceful livelihood. Arderne lived in an age of chivalry when knights and gentlemen wore heavy armour, spending many hours in the saddle in all weathers. As a natural consequence, ischiorectal abscess was a very common complaint, the usual sequel being fistula-in-ano. Now it was Arderne who boldly invented the operation for cutting down and freely opening up the fistula. His description of the operation, with the woodcut illustrating the patient in the lithotomy position, differs very little from those given in modern textbooks.

Books [2] were rare in those days and yet he managed to write his "System of Surgery," which was founded on his experiences in the Hundred Years War. This book may be seen in the British Museum—a beautiful example of early English literature. It is interesting to note that he refers to his patients by their armorial bearings, never by their name.

In chronological order we come to one of the most remarkable and outstanding characters in the whole of surgical history, Ambroise Paré [3], the father of French surgery. Born of poor parents, he raised himself to a position that gave him a reputation famous throughout the world. Like every able surgeon he was an extremely shrewd observer; he pondered over his experiences and then took action. His life was spent with the armies and his entire surgical training was gained in camps.

In 1537 he was made surgeon to Colonel-General of Infantry René de Montijean, with whom he fought his first campaign in Italy. This lasted three years. Paré,

on joining up at the age of 26 years, had never seen a recent gunshot wound. He was horrified, and not without reason, at the treatment of wounds then in vogue, by pouring boiling oil into the wound to staunch the hæmorrhage; and, if the supply of oil failed, the red-hot iron was used as a cautery. He first observed that the patients who were treated by the surgeons were much worse the next morning than those who had been left alone. He then acted, and, fearful of the result, commenced the treatment of wounds by the application of a dressing, viz., "digestive made of the yolk of an egg, oil of roses and turpentine." Thus it came about that a revolution in the treatment of gunshot wounds had begun.

At the siege of Danvilliers in 1552, he performed an amputation, omitting for the first time the use of the cautery, and so brought into practice for the first time the ligature of blood-vessels after amputation, as he says, "binding them round with a strong thread after they had been picked up by a crow's beak forceps." Thus the most important procedure in the technique of any operation of to-day was brought into being through the genius of Ambroise Paré, a military surgeon.

In addition to the above two remarkable achievements he invented the method of reducing a dislocated shoulder by the heel in the axilla; he noted metastatic abscesses in pyæmia; and he recognized fractures of the skull by contrecoup. Thus it is not difficult for us to conclude that, like Machaon, he was an extremely versatile character. His book on "The manner of treating wounds made by Arquebus and other Firearms, and those made by Arrows, Darts and the like; and also Burns made especially by Gunpowder" is a perfect mine of information on all subjects. As Mr. Stephen Paget says of him, "Save Art and Politics, the works of Paré contain every possible subject: anatomy and physiology, medicine, surgery, obstetrics, state medicine, pathology, pharmacy, natural history, demonology, and much else. The divine origin of diseases, the influence of the stars, the power of devils, the nature of the soul, the history of medicine—he ranges from these to the tricks of beggars and of quacks, the homely remedies of old women, the folly of tight-lacing, the best sort of tooth powder and the right way to make pap for a baby."

Johnson's translation of "The works of that famous Chirurgion Ambrose Paré out of Latin, compared diligently with the French," became the standard textbook for English surgeons from its first edition in 1634 until at least the end of the century.

In England John Woodall [4] may be considered the contemporary of Paré. It is largely due to him that the great traditions of Elizabethan surgery were transmitted to the surgeons of the Commonwealth and Restoration. Like all Elizabethan surgeons, he had gained his experience in the field. In 1591 he served as surgeon to Lord Willoughby's regiment. In 1627 he was specially ordered to Portsmouth to attend the wounded returning from the Rochelle expedition. His chief works were "The Surgeon's Mate, or Military and Domestique Surgery," and "The Viaticum: being the Pathway to the Surgeon's Chest." Both these books are profusely illustrated with either a naval or military background. At this period they were classed as the standard textbooks of the day. What he wrote of gunshot wounds then is still perfectly true to-day. "No wound of gunshot can be said to be a simple wound, neither was there any artist that could truly say he healed any gunshot wound by first intention."

Woodall also invented the modern trephine, worked by hand and fitted with the

removable centre pin. Of this instrument he wrote as "being of my own composing; is more compendious and of more facility than is the trepan" which had no centre pin and was worked by a brace, one end of which rested against the surgeon's breast. Although other methods of opening the skull are now gradually superseding the trephine, the modern pattern of this instrument is practically identical with that invented by Woodall.

Following Woodall came Richard Wiseman [5], and few men have exercised so wide an influence over English surgery as he. How did he learn his craft? At the age of 21 he entered the Dutch naval service in which he served in several naval actions. Then, returning to England he joined the army of King Charles I and was present at the battles of Worcester, Truro and Dunbar; he served throughout the campaign in the West of England. When, however, the Commonwealth made the country uncomfortable for the Royalists, he served as a surgeon for many years in the Spanish navy.

Wiseman formed an important link between the Elizabethan surgeons and Cheselden and Percivall Pott, who may be considered to represent the dawn of modern surgery. He may be looked upon as being the first consulting surgeon, since he never saw a patient unless recommended by another doctor. He was a prolific writer, chiefly on such subjects as tumours, ulcers, the King's evil, and so forth.

Up to this period we see very clearly that wars produced the most skilful surgeons of the time, and it is on this foundation, rough and coarse though it may appear to us in these enlightened days, that the fabric of surgery was built. In 1674, Morel invented the tourniquet, at the siege of Besançon—another valuable addition to our craft. Some years later, Petit modified this by adding the screw.

Now we come to the Napoleonic wars in which Larrey, surgeon-in-chief to the Grand Army, became the foremost surgeon of his time. He may be looked upon as a worthy successor to the great Ambroise Paré. His experience was gained in sixty great battles, including Waterloo, and four hundred engagements. He himself was wounded three times. Larrey was the first to introduce plaster-of-Paris as a splinting material. He also invented what is known as "Larrey's bandage," which is after the fashion of a many-tail with its edges glued together. His method of disarticulating the humerus at the shoulder-joint by the external racquet is still practised. It is said that he performed two hundred amputations in a single day, and Napoleon I referred to him as being the most virtuous of men.

His contemporary was George James Guthrie [6] who has been termed the English Larrey. He, too, saw an extraordinary amount of active service as an assistant-surgeon in North America and also in the Peninsular war, during which he earned the special commendation of the Duke of Wellington. He was attached to the 29th regiment when he was only 16, and his colonel was only 24. Yet it was said that no regiment was better commanded or better doctored. He was the principal medical officer at the battle of Albuera at the age of 26. On one evening he had three thousand wounded on his hands, with four wagons, and only such equipment as the regimental surgeons carried in their panniers, the nearest village being seven miles away. After being placed on a period of half-pay he became a distinguished ophthalmic surgeon. He introduced the straight splint for fracture of the femur, and was the first to tie both ends of the artery at the site of injury, contrary to

the teaching of the great John Hunter. He described in detail the compressor urethræ muscle—still known as Guthrie's muscle. He wrote "A Treatise on Gunshot Wounds," which became the standard work of the day, and later, "Operations for the Formation of an Artificial Pupil," and "Lectures on the Operative Surgery of the Eye." An interesting link with the past lies in the fact that the father of Sir D'Arcy Power was an assistant-surgeon to Guthrie.

The Crimean War left us two important legacies. In 1855 Mr. Sampson Gamgee [7] became surgeon to the British Italian Legion, being in charge of the hospital at Malta where many of the wounded were treated; but it was not until 1880 that he gave his epoch-making lecture to students at Birmingham on "Absorbent and Antiseptic Surgical Dressings." Thus the poultice was supplanted by the absorbent dry dressing, which in its turn was followed by the cyanide or iodoform gauze and finally by the sterile gauze of to-day. Again another revolution in the treatment of wounds had begun.

Just before this, in 1841, Thomas Spencer Wells [8] joined the Royal Navy as a surgeon. He acquired such a reputation as a surgeon in Malta that the Fellowship of the Royal College of Surgeons of England was conferred upon him in 1844. In 1848 he resigned his commission and visited Paris to see the gunshot wounds coming from the barricades. Then he went out to the Crimea and became surgeon to the civil hospital in Smyrna where he used his forci-pressure forceps which, almost a hundred years afterwards, still bear his honoured name.

Thus two of the most valuable assets in our craft, viz., the dry dressing and the Spencer Wells forceps, were a direct outcome of experiences in the Crimean War.

Finally we come to the effect of the last Great War upon the practice of surgery. In estimating this we should remember that by this time the realm of surgery had extended its boundaries and become one vast expanse, and yet there cannot be found a single subdivision which did not receive benefit to a greater or lesser degree.

It is manifestly impossible to refer to the work of every individual surgeon, but we may discuss with advantage certain general aspects attributable to the Great War.

(1) *The rise of orthopædic surgery.*—Most of us present are old enough to remember the appalling scenes which occurred more especially during the first two years of the war. The wounded were numbered by thousands; the wounds were of a severity hitherto unknown; the heaviness of their infection passed the bounds of the most vivid imagination, while the complicated nature of the fractures exacted a heavy toll in crippling disabilities and death.

Under such conditions it became evident that the very magnitude of this stupendous task lay beyond the power of the Army and Navy medical resources. Consequently, with great foresight, the Medical Director-General of the Army invoked the aid of Lord Moynihan, Sir Harold Stiles and Sir Robert Jones, and the Medical Director-General of the Navy, that of Sir Watson Cheyne, Sir George Lenthal Cheatle and Sir George Turner.

Sir Robert Jones quickly gathered together a band of enthusiastic surgeons, defined the scope of orthopædic surgery and carried his ideas into effect—not without some opposition. However, his skill and tact smoothed away all prejudice. Consequently special hospitals for the treatment of fractured femur were set up in France, and orthopædic hospitals sprang up at home. This tremendous feat of

organization constituted a personal triumph for Sir Robert Jones, and there is not an orthopædic surgeon living to-day who does not owe a heavy debt to his guidance and inspiration.

The practical results of this new régime immediately became evident. The treatment of fractured femur, largely owing to the work of Pearson and Maurice Sinclair, underwent a revolution. The Thomas's knee splint, invented by Sir Robert Jones's uncle some seventy years previously, may be said to have been born anew. To-day there is not a single modern police-ambulance which does not carry one as part of its standard equipment.

Our ideas of amputations were completely changed. For instance, in the region of the foot, such methods as those devised by Chopart and Pirogoff were relegated to memories of the past, while the value of the Syme was greatly enhanced. The old sites of election disappeared and, by co-operation with the manufacturers of artificial limbs, new ones took their place.

Thus out of all this experience have arisen the true orthopædic surgeons of to-day, one or two of whom are attached to every large hospital in every civilized community.

(2) *The value of co-operation among surgeons themselves, i.e., team work.*—A year before the great war Sir Rickman J. Godlee wrote: "We are all brothers working hand in hand for the advancement of our science." No sooner had the war begun than this great truth became evident to everyone. "The business [9] of surgery is individualistic, competitive, and secretive, but the science of surgery is altruistic, public and above all co-operative." Those words may be applied very aptly to the medical branches of our three fighting services to-day.

The war in this respect exerted a most profound influence over British surgery whose insulation or insularity broke down completely when brought into close contact with contemporary French and American practice. As a natural sequel surgical units have grown up in our hospitals where team work among the surgical specialists forms the most important feature of the system.

Nothing but this great upheaval could have brought about such an inestimable benefit. Our conservative and somewhat narrow views were in a moment transformed to a more liberal and broader plane on which we are now building our hospital organization. Not only has this resulted in specialism in the different branches of surgery being brought to a greater state of perfection, but as we are sometimes apt to forget, the patient receives the reward of such a benefit.

(3) *The introduction of new types of antiseptics.*—The heavy infection of the wounds served to stimulate a thorough search for more effective antiseptics. Early in 1915 an opportunity arose for me to visit Edinburgh, as my ship was based on Rosyth. Just previously to that, the work of Lorrain Smith and Ritchie resulted in the production of the Edinburgh University solution, or what is generally known as eusol. About the same time Dakin discovered a similar solution and thus the Carrel-Dakin method of treating infected wounds came into use. Later, through the agencies of chemists in the laboratories, a valuable class of antiseptics derived from synthetic dyes sprang up—such as brilliant green, flavine and acriflavine. Thus it has come about that carbolic acid and perchloride of mercury do not now enjoy their pre-war popularity.

(4) *The great stride forward made in the plastic surgery of the face, particularly*

the nose and lips.—Examples of the dreadful disfigurement caused by modern projectiles may still be seen in that part of the museum of the Royal College of Surgeons of England which has been called the chamber of horrors. Here are a series of plaster casts moulded from faces which had lost one or more of their features—faces so ghastly and yet so life-like! The mental anguish which patients so mutilated must have suffered can be better imagined than described. It can only be measured by the immensity of their gratitude when it was found possible to reconstruct a nose, lip or jaw from their own flesh and blood, by means of the pedicle tubed graft. The work of Sir Harold Gillies at Aldershot was that of a pioneer. Such patient, delicate and beautiful artistry has justly earned its place in the forefront of specialized surgery.

The enormous amount of surgical work performed during the war lies outside the scope of this address, and only very brief references have been made to four aspects of it. However, I would remind you of the work of Bayliss and Dale in rescuing from chaos the problem of surgical shock, the work of Sir George Makins in the surgery of the blood-vessels, and the great advances made in the surgery of the chest. All this will suffice to indicate that at least some good emerged from that terrible disaster which almost overwhelmed us in those eventful years from 1914 to 1918.

In conclusion I must pay my grateful tribute to Sir D'Arcy Power, from whose writings and eponyms in the *British Journal of Surgery* I have quoted freely.

Finally, let us not forget that most of those characters, whom I have briefly mentioned, denote our own predecessors in the fighting services. We have inherited their legacies, handed down through each succeeding period of our history, and so, whatever the future may hold in store for the *science* of surgery, her *craft* must ever reflect the glories of the past.

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PYOSIS MANSONI AND ALLIED INFECTIONS OF THE SKIN IN INDIA.

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The group of infections under review comprises a variety of clinical conditions having as a common factor that their exudates on direct examination show pus cells with intracellular and extracellular Gram-positive diplococci.

Clinically, the group appears to fall naturally into three subdivisions characterized by three types of eruption: (1) Bullous or vesicular lesions; (2) follicular and ulcerative lesions; (3) eczematoid lesions.

These subdivisions are, however, not absolutely distinct. Smith [1], in his recent Atlas of Tropical (African) Skin Diseases, adopts a similar classification, and Castellani and Chalmers [2, 3] classify their True Dermatobacterioses in comparable groups.

Pyosis Mansoni.

The most distinct member of the group is the condition commonly known as pyosis mansoni (Manson's pyosis, Manson's impetigo, pemphigus contagiosus).

This is a bullous phlyctenular eruption, associated in India with monsoon weather, in which it tends to occur in epidemic form. The lesions, which are pathologically a bullous impetigo, are found typically in the axillæ, or on the neck and face, with or without associated lesions on the trunk and limbs.

The delicate bullæ may dry up and desquamate, or may become semi-purulent and encrust. Both conditions may occur in the same case.

Ordinarily a relatively trivial condition, which clears up within a week or ten days under appropriate local treatment, it may not infrequently prove annoyingly persistent until an autogenous vaccine is given.

It is especially well known in Asia and is described by Smith [1] in his African series.

A full description of Manson's pyosis will be found in Byam and Archibald, vol. iii [3]. An interesting account of an outbreak in Multan is given by Eccles and Dorling in vol. lviii of this Journal [4].

A smear of the fluid aspirated from any of these bullæ shows polymorphonuclear cells with intracellular and extracellular Gram-positive diplococci. No chains or staphylococcal groups were detected in any of our cases.

On culture, the growth is indistinguishable from that of *Staphylococcus pyogenes aureus*. In our series it was noted, however, that after culture

the diplococcal arrangement was never altogether lost, and occasionally predominated.

We found that an autogenous vaccine whenever used was followed by a rapid resolution. As a routine, a mixed strain vaccine prepared from the first four or five cases in each season was employed, usually with success, but with a marked failure in one case. After having persisted for nearly three weeks this case cleared up completely within three days after one injection of autogenous vaccine. Incidentally, it had been noted in this case that only extracellular diplococci were visible in the smear of the bullous fluid.

The cases were all encountered in Karachi during the years 1929, 1931 and 1932, leave having intervened in 1930.

1929, one case (August), severe; persisted until an autogenous vaccine was given and then cleared up rapidly. This case was in an officer of the unit in which an outbreak later occurred in Multan and was described by Eccles and Dorling.

1931, twelve cases (July, August), generally mild; three cases cleared up within forty-eight hours under local treatment before the vaccine was available—the remainder responded to a mixed strain vaccine prepared from the earlier cases.

1932, thirty-three cases (mid June to mid October), some slight, several severe, the majority mild. A mixed strain vaccine was effective in all these cases except one, which did not respond to treatment until an autogenous vaccine was prepared and used. Five of the cases were officers, and two of them wives of infected officers.

In many of the above cases there was a recent history of bathing in Karachi harbour area. No evidence of association in barracks was obtained.

Treatment. A vaccine 150, 250 and 450 million at four-day intervals, was found convenient and effective. Frequently the third dose was not required. *Local.* For the face we preferred a soft paste containing 6 per cent resorcin and 3 per cent oil of cade, or the proprietary resinol ointment. For other lesions 1 per cent mercurochrome was found most useful. Ungt. hydrarg. nit. dil. was considered not so good, but useful and less expensive. Undamaged bullæ were left severely alone.

ALLIED INFECTIONS.

(1) *Other Bullous or Vesicular Eruptions.*—(*a*) Pyosis corletti. Several of the cases in our series appeared to correspond very closely with the description of pyosis corletti in Byam and Archibald [3]. In view of the absence of distinction in incidence they have been recorded as Manson's pyosis, of which it is suggested that the condition may be a clinical variant.

Pyosis tropica and pyosis palmaris (*v.* Byam and Archibald) were not encountered in our series.

(*b*) Dermatitis bullosa plantaris. Foot tetter. One case, a govern-

ment civil servant, reported in February 1932, with a history of several years' affliction, exacerbation during the hot weather, and total disappearance of the eruption during his visits to England. The site was on the plantar skin under the arch and on the adjacent inner margin of the foot; the slight itching as the sago-like vesicles became superficial and the subsequent flaking were typical. We were surprised to find in smears of the exiguous vesicular fluid the diplococcus already described and no streptococcal forms, and to see the case respond to the autogenous vaccine prepared. Twelve injections were given rising in ten weeks to 1,000 million. The vesicles began to occur singly instead of in twos and threes, and were smaller; they occurred at gradually increasing intervals, and ceased entirely before the monsoon weather commenced. No local treatment was given.

(2) *Follicular and Ulcerative Lesions.*—(*a*) Sycosis barbæ, one case (May, 1932). A typical severe case, the exudate from infected follicles showed the diplococcus already described, and definite improvement followed the use of an autogenous vaccine—a stock staphylococcal vaccine of furuncular origin had previously been tried without success. Locally, mechanical epilation and a resorcin and oil of cade ointment were employed, and the case cleared up completely.

(*b*) Septic ulcer (infection of areolar tissue of shin). One case (December 1932). A chronic indolent ulcer the size of a sixpence on the shin following a kick at football. The case was taken over when the condition was already chronic. The same diplococcus was found, and definite improvement followed three injections of stock vaccine.

(3) *Eczematoid Lesions.*—(*a*) Dermatitis of the hands. Six cases (May, November, December 1923). These cases appeared to be primarily a sensitization dermatitis with secondary infection and were of the moist eczematous type. In all of them the diplococcus was demonstrated in the local exudate. One, a very severe case, resolved with an autogenous vaccine but only to relapse again. This patient had chronic seborrhœa of the scalp. The other five cleared up completely with the stock vaccine and protective treatment.

(*b*) Dermatitis of the foot. Nine cases (May, July, October, November 1932). A semi-purulent dermatitis, possibly secondary to an epidermophyton infection which we were unable to demonstrate. In all of them the same diplococcus was found. Two of the cases (July) were Indian soldiers and were the only Indians in the series. All reacted to the stock vaccine. In three cases only one foot was involved.

It may be noted that among the conditions recorded above are several which are usually associated with streptococcal infection. Foot tetter is generally accepted as streptococcal, and in Byam and Archibald it is stated that virulent streptococci have been isolated.

In his cases of Manson's pyosis, Smith isolated streptococci by Griffon's method, and he appears to consider the diplococcus demonstrated in his cases to be a streptococcal form. He also describes an eczema-like

dermatitis, similar to those recorded above, in which he demonstrated the diplococcus and isolated streptococci by the same technique. One of his photomicrographs showing diplococci and polymorphs represents very closely the condition seen in many of our cases.

Impetigo as encountered in Europe is generally accepted as streptococcal. Macleod [5] describes the impetigo vesicle with "chains of streptococci situated about the floor of the blister, and clusters of staphylococci immediately beneath the roof and towards the margin."

Castellani and Chalmers [2, 3] use the generic name Aurococcus for the organism, and indicate that it is a form of Staphylococcus. The term Aurococcus was used by Winslow and Rogers in 1906 [6] to indicate a genus in their original grouping of the coccaceæ, but in 1920 it was discarded by Winslow and his collaborators [7] on their revision of this classification, and is no longer in general use.

In none of the cases in our series were any chain forms detected on direct examination. Culture under anaerobic conditions was not performed. Throughout the series, culture produced on each occasion a golden staphylococcal growth, showing some degree of persistence of the original diplococcal form.

In the majority of the cases, a stock vaccine of this organism obtained from mixed sources appeared to be specific in action. In some of these a stock *S. aureus* and *S. albus* vaccine of furuncular origin had previously been tried without success. In the remaining cases an autogenous vaccine was used, always with specific effect.

In view of this, we suggest that the diplococcus demonstrated in our cases is a form, perhaps a strain or a group of strains, of *Staphylococcus pyogenes aureus.*

We hope that other workers in India will pursue the matter further.

We are indebted to Brevet-Colonel G. G. Tabuteau, D.S.O., R.A.M.C., V.H.S., and to Lieutenant-Colonel A. J. Symes, I.M.S., for permission to submit this report for publication.

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Editorial.

ON THE STATE OF THE PUBLIC HEALTH.

In the December number of the Journal, 1933, we dealt with several of the sections of Sir George Newman's Report to the Minister of Health. The Epidemiological Section contains some interesting observations on enteric fever, influenza, infectious diseases of the nervous system, and diabetes.

During the year 1932 there were 2,545 cases of enteric fever (including paratyphoid fever). The deaths numbered 258, of which 219 were attributed to typhoid and 39 to paratyphoid infection. The distinction between typhoid fever and paratyphoid fever is considered not to be a sharp one and the numbers are only relative.

There are some valuable notes on water-borne enteric fever. The outbreaks at Malton and in the Denby and the Cumberworth Urban District were water-borne, and emphasize the importance of the persistence of the *Bacillus typhosus* in sewage and river water to which we drew attention in an Editorial in 1932 and on which Sir George Newman commented in his reports for 1930 and 1931. It is two years since the Epping outbreak ceased, yet the *B. paratyphosus* can still be recovered from the sewage effluent.

Sir George Newman points out that a few sporadic cases of enteric fever, occurring weeks apart but reappearing year by year, may be associated with a polluted water supply, and the endemicity ceases on the provision of a pure one. A good illustration of this is the experience of a mental hospital in Yorkshire, with a population of 2,000. From 1908 to 1917 enteric fever was endemic, the annual number of cases was about 12, but in 1915 there were 62 and in 1917 125 cases. When a new water supply was provided the cases ceased completely.

A considerable number of water-borne and milk-borne outbreaks have been the result of failure to diagnose the initial cases. The prevention of an outbreak lies in the early recognition of the sporadic patient, and the Ministry consider that any case of continued pyrexia, in which the physical signs are indefinite, should be regarded provisionally as one of the enteric group. Sometimes influenza is a cloak for typhoid or paratyphoid fever.

Influenza was again prevalent in 1932. The epidemic first affected the Midland and Northern areas ; it developed later in London and the South generally. From the reports of Regional Medical Officers, and from the information supplied by the National Health Approved Insurance Societies as regards the number of persons on sickness benefit, it became evident

that the epidemic was of considerable severity and had invaded all parts of the country. It was not so severe as that of 1928-29 ; the mortality was not excessive. The direct verification of the influenza virus has hitherto proved impracticable ; the effect of the various organisms found cannot be tested owing to the absence of any experimentallv susceptible animals. No general method of immunization is, therefore, at present available.

Encephalitis lethargica seems to be diminishing in prevalence, but the number of deaths has not decreased in proportion to the number of cases notified. There is a continued excess of deaths over cases, probably due partly to some cases not being notified and partly to patients notified in previous years dying after a period of chronicity. Sir George Newman states that though epidemic encephalitis is tending to disappear there is no guarantee that it may not reappear in the future. For there seems to be some doubt whether the advancing degenerative changes in chronic cases may not be due to foci of active infection still lurking in the brain. Mr. Hill in his report on the work of the Post-encephalitis Lethargica Unit in the Northern Hospital states that the available post-mortem evidence points to a persistence and diffusion of active infection in the brains of those chronic cases which show progressive deterioration. It has yet to be proved, however, that chronic cases are capable of transmitting the infection.

There were 656 cases of poliomyelitis in 1932 compared with 339 in 1931 and 506 in 1930. It is stated that opinion is still divided as to the value of convalescent serum in the treatment of poliomyelitis. The disease is so varied in its effects that the issue of any individual case in the initial or pre-paralytic stages cannot be stated with assurance. While the futility of serum treatment in the paralytic stage has become obvious, it has not been so easy to assess its value in the pre-paralytic stage. All observers are agreed that convalescent serum is unlikely to be harmful and several have reported that when given in the pre-paralytic stage it certainly moderates the symptoms and probably averts paralysis. Animal experiments have definitely proved that under certain conditions the virus of the disease can be neutralized by convalescent serum.

It has been suggested that the virus of poliomyelitis is widely spread in the community, and the comparative freedom of adults from attack is due to naturally acquired immunity, as substances capable of neutralizing the virus have been demonstrated in the blood of persons who have been exposed to infection but have had no manifestations of the disease. In America, where poliomyelitis has been very prevalent, Flexner and others have introduced a method of passive immunization in children by the use of normal adult blood. During the epidemic in Philadelphia and other places in Pennsylvania, the method was widely applied and certain favourable results have been reported.

The incidence of cerebro-spinal fever has been increasing of late years. In 1930 there were 644 cases notified; in 1931, 2,157 cases were notified, and in 1932, 2,136 cases. There is no indication at present that the

epidemic is decreasing either in prevalence or in case severity. The serological types of meningococci isolated from the cerebro-spinal fluid have remained fairly constant. Classified according to the manner suggested at the Second International Conference on the Standardization of Sera and Serological Tests held in Paris in 1922, the strains from epidemic areas have been found to belong chiefly (92 per cent) to Group I (this includes Gordon's types 1 and 3), only 8 per cent being placed in Group II. In non-epidemic areas, Group II was nearly as prevalent as Group I. There is a strong suspicion that Group II is concerned in the sporadic type of the disease, but as an epidemic develops Group I predominates in the strains sent to the Ministry's laboratory.

For the preparation of therapeutic serum freshly isolated strains, chiefly from Group I, have been sent from the Ministry's laboratory to the British serum manufacturers for the inoculation of horses providing the serum.

For 421 cases treated on the general lines of the Ministry's memorandum of March, 1932, the mortality was 28·9 per cent. For 122 cases treated within the first three days of illness, the rate was 23·8 per cent. For 123 cases not treated with intrathecal injections of serum the mortality was 63·4 per cent.

It has been found that "sporadic" cases, mainly due to Group II organisms, are more difficult to treat than the "epidemic" cases; the mortality rate for the former was 48·3 per cent, and 32·3 per cent for 509 epidemic cases.

The treatment of diabetes is discussed at length and attention is drawn to the modern view that this disease is not merely a derangement of carbohydrate metabolism, but is of much wider scope, involving all the metabolic processes, including those relating to protein and fats. It is realized that 58 per cent of the protein molecule and 10 per cent of the fat molecule are consumed in the body as sugar. It is also established that a high protein diet causes a high metabolism and that removal of the carbohydrate from the diet without reduction of fat and protein is liable to bring on coma. Through the application of these principles combined with treatment by insulin, coma, especially in young diabetics, is relatively infrequent, and much less fatal when it does occur.

A number of apparently divergent dietaries are now used in the treatment of diabetes. The present tendency is to increase the carbohydrate in the diet and to avoid excess of fat. The returns of the National Health Insurance Service show that the use of insulin is steadily increasing. It is estimated that to insured persons alone about 5 million units were issued in 1927 in England and about 57 million units in 1931.

The number of deaths from diabetes increased from 4,545 in 1922 to 5,660 in 1930. The explanation of this apparent increase in the incidence of diabetes is to be found partly in a changing age and sex distribution of the population; there is now a greater number of persons at risk at ages of maximum mortality. At all ages during the working years of life the

mortality from diabetes is now lower than formerly. Increases in mortality are limited to the later ages, and, except at ages over 75, the increases are becoming smaller. There is also now greater attention to diagnosis; examination of the urine is responsible for the discovery of a greater number of diabetics and increased certification of diabetes as a cause of death.

The number of deaths certified in 1932 to be due to tuberculosis of all forms was 33,658 compared with 35,818 in 1931. The death-rates of 1932 are the lowest recorded in this country. The decline in mortality from pulmonary tuberculosis is stated to be exceptionally great, but the fall in mortality has been greatest in childhood and after middle life. The decline in non-pulmonary tuberculosis has been remarkable; the death-rate from this cause has fallen by 37 per cent in the last ten years.

Examinations of contacts with tuberculous persons is steadily increasing in extent. In 1932, 3,545 cases of tuberculosis were discovered among contacts. In the homes of 40,000 new cases of tuberculosis, 2,014 adults suffering from pulmonary tuberculosis were found by "contact" examination. This indicates the necessity for the home investigation of every case of tuberculosis so as to find the primary infecting case. This is of special importance with a view to preventing the spread of infection. In children the infection is usually derived from a known or unsuspected tuberculous member of the family or through milk from a tuberculous cow. In young children the infection is more likely to be from tuberculous milk, and co-operation between the Tuberculosis Officer and the veterinary authorities should receive more attention than has hitherto been the case.

In some areas special attention has been paid to the removal of infants and young children from the infected home. This is known as the Grancher System and has been adopted on a considerable scale in France. This system is stated to interfere with the continuity of the child's home life. Also, it is usually less economical and more unsatisfactory to maintain several children of a family in an institution than to remove and efficiently treat the adult patient who is the potential source of infection.

The rehousing of the families containing a tuberculous member, so as to isolate the patient within the family and to provide a healthy environment beneficial both to the patient and family, is receiving greater attention.

M. Henri Spahlinger's statements regarding his preparation of antigens with special reference to tuberculosis have been submitted to the Medical Research Council and other authorities. They all consider, on the evidence available, that a clinical investigation of the immunizing value of the human vaccines in human beings would be undesirable. The Ministry of Agriculture and Fisheries is considering an experimental trial with his bovine vaccine on animals, and M. Spahlinger has undertaken to supply the vaccine as soon as it can be prepared.

In the section dealing with the relation of food to health and disease attention is drawn to a new problem in food adulteration.

Before the passing of the Sale of Food and Drugs Act in 1875, adulteration of food had become a serious matter, and in that year 20 per cent of all articles of food submitted to Public Analysts were found to be adulterated. Since then the adulteration rate has gradually fallen and is now about 5 per cent. But adulteration has given place to scientific treatment with the object of "improving" the colour, taste and keeping qualities of food. Some of these artifices are above suspicion, others may affect the nutrition of the body and become a contributory cause of lowered vitality. The food may be so treated as to give a totally false idea of its nutritive value. Cheap grades of food may be given an attractive appearance. An interesting case of this is butter. The substance responsible for the aroma of butter has been identified as diacetyl. The body first formed by bacterial action is acetyl-methyl-carbinol, from which the strongly smelling diacetyl is formed by oxidation. The best dairy butter may contain about 0·0005 per cent of diacetyl which can be distilled off and the amount determined by converting it into dimethyl-glyoxime which gives intensely red crystals with a nickel salt. Diacetyl can be made artificially and a trace (5 to 10 parts per million of butter) could hardly be considered a danger to health. Diacetyl, however, exerts a definite oxidizing action on fats and may have a destructive effect on the vitamin A in butter. Even if this were not so, it can hardly be in the consumer's interest that a food which has deteriorated should be made to convey the impression that it is absolutely fresh.

Another practice which may be detrimental to health is the tendency of manufacturers to add vitamins empirically to a variety of foods without a consideration of the results that may accrue. The addition of vitamin D to bread has been made by a firm of bakers so that the vitamin content may be equivalent to that of butter, weight for weight. This would mean an undesirable intake of the vitamin, when it is considered that many pounds of bread are eaten for each pound of butter consumed. In these circumstances there may be a danger of hyper-vitaminosis, especially in children, when the diet is lacking in milk or when the calcium intake is high and the phosphorus intake low. Bread is an unsuitable vehicle for the administration of vitamin D, and if the practice is persisted in Local Authorities may have to consider whether the exercise of the provisions of the Bread Acts or of the Food and Drugs (Adulteration) Act would not provide appropriate protection.

Clinical and other Notes.

EXTRACTS FROM A REGISTER OF SURGICAL OPERATIONS.

By Major W. L. E. FRETZ,
Royal Army Medical Corps.

These notes have been grouped together under the above heading in the hope that they may be of sufficient interest and out of the ordinary run of military practice to warrant their publication, more especially as in a recent circular letter from the War Office, Surgical Departments have been upbraided for being the Silent Service of the Corps. The cases have all occurred, with the exception of the two of puerperal septicæmia, in the Surgical or Gynæcological Department of the Rawalpindi and Murree British Military Hospitals in the course of the last twelve months.

(1) Recurrent Dislocation of the Shoulder treated by Capsulorrhaphy.

The patient, a fairly well developed man, was admitted with the usual history of "always putting his shoulder out," and was very anxious to have something done.

The joint was exposed by an incision posterior to the axillary vessels, freeing and retracting the circumflex nerve and the lower border of the subscapularis muscle. A lozenge-shaped piece of the capsule was excised and then the edges were stitched together with overlapping stitches. The wound was closed and a drain left in. Healing was satisfactory but there was unfortunately some paralysis of the deltoid due to an energetic retraction of the circumflex nerve, but this recovered with massage and faradism. The patient has been seen again twelve months after the operation and though he says he has some weakness of the shoulder, there has been no recurrence of the disability and he can start up an aeroplane engine by swinging the propeller.

I was fortunate in having the assistance at the operation of Major N. Cantlie, F.R.C.S., R.A.M.C., whose knowledge of the anatomy of the area was invaluable.

(2) Cæco-plication for Chronic Constipation.

The patient was sent to hospital as a case of probable chronic appendicitis, owing to recurrent attacks of dyspepsia and pains in the right side, accompanied by pyrexia. She stated that she had been constipated for years and had been in the habit of treating herself with an enema twice a day for about a year.

Laparotomy revealed an appendix with a fair amount of adhesions and evidence of chronic inflammatory change and also a very atonic thin-walled and ballooned cæcum. The appendix was removed and the cæcum plicated by stitching together two adjacent bands after painting the enclosed area of gut with iodine.

(For full descriptions of this operation and that in Case 1, see "Practical Surgery," by Victor Pauchet, vol. 1 and vol. 2).

The after-history was interesting, as she made an uninterrupted convalescence, having a normal motion daily after the ordinary post-operation aperient. On being discharged her enema syringe was left behind, and when last seen her outlook on life was completely changed.

(3) Rupture of Testis.

An officer was admitted to hospital with a history of having been hit on the testis by a hockey ball. He had had previous blows on the testicle which had swelled and not recovered its normal size: he was sent in as suffering from a hæmatocele. On examination: the scrotal tissue was freely movable; the testicle was found to be heavy and gave a feeling of fluctuation; the epididymis could not be made out, but the vas and cord felt normal.

As a case with a similar history and physical signs had occurred in the surgical ward a fortnight previously, and which on operation had turned out to be one of malignant disease, an immediate operation in this case was decided upon. On delivery of the testicle into the inguinal incision, and on opening the tunica vaginalis, allowing evagination of the testis, a complete rupture of the tunica albuginea with extrusion of testicular substance was found. Orchidectomy was performed and the patient made an uneventful recovery.

This case, together with the one of malignant disease mentioned, is interesting as showing the advantage of exploratory operation on a non-absorbing hæmatocele.

(4) "Appendices that were Not."

Under this caption the following cases are grouped together and are instances of "unexpected findings" (a euphuism for errors in diagnosis).

(*a*) *Partial Intestinal Obstruction due to an Obliterated Umbilical Artery.*

The patient, complaining of abdominal pain and rigidity, was transferred to the British Military Hospital, Murree, for operation as a case of ? appendicitis. When seen, although the physical signs were fairly well marked, the rigidity was more in the nature of a guarding of the rectus abdominis. The abdomen was therefore opened by a right paramedian incision, instead of the usual gridiron incision. The appendix was very long and well developed, and though not inflamed it was removed. The intestines lying in the pelvis were observed to be red and congested, and showing signs of partial strangulation. On searching for the cause of this, a falciform ligament was found composed of a fold of peritoneum with a fibrous cord in its free margin extending from the umbilicus outwards and down the right side of the anterior abdominal wall, expanding to about an inch in width at its lower end. After excluding a Meckel's diverticulum or urachus, the cord was eventually recognized as the obliterated umbilical artery,

which had developed a mesentery. The edge of this had evidently been the cause of the strangulation. It was removed by ligature and excision, and the patient made an uneventful recovery, with disappearance of symptoms.

In the literature at my disposal I have been unable to find this condition mentioned as a cause for constriction of the gut.

(b) Ovarian Cyst.

The patient was admitted to hospital with a history of an acute attack of pain in the right side on the previous day, along with fever.

When she was seen there was very marked tenderness with rigidity in the right iliac fossa, and on palpation a mass could be felt. The tongue was very dirty, the temperature 102° F., and the patient evidently suffering from toxæmia. The condition was thought to be an appendix abscess and operation was decided upon.

On opening the abdomen through a gridiron incision, blood-stained peritoneal fluid escaped. A lump, thought at first to be the cæcum, was isolated by gauze dissection and was then recognized to be an ovarian cyst, having been adherent and being now in a semi-gangrenous condition. It was brought into the wound as far as possible and the pedicle clamped. The clamp was held by an assistant and the tumour removed, but before the pedicle could be transfixed the clamp slipped and the pedicle dropped into the pelvis, with the ovarian artery spouting. The incision was rapidly extended by freeing the aponeurosis from the rectus sheath, and fortunately the bleeding pedicle was recovered and the wound closed; this experience shows that a gridiron incision is not an ideal one through which to remove an ovarian cyst.

The patient, a phlegmatic Yorkshirewoman, recovered quite happily.

(*To be continued.*)

A CASE WITH A MORAL.

By Major E. V. WHITBY,
Royal Army Medical Corps.

An infant, age 14 months, was sent recently to the Radiological Department, Citadel Hospital, Cairo, with a history of having swallowed the spring of a clothes peg two days previously.

A radiogram showed the spring to be in the pyloric end of the stomach. It appeared to be of rather a large size, when compared with the small size of the stomach, and presented a fearsome-looking hook.

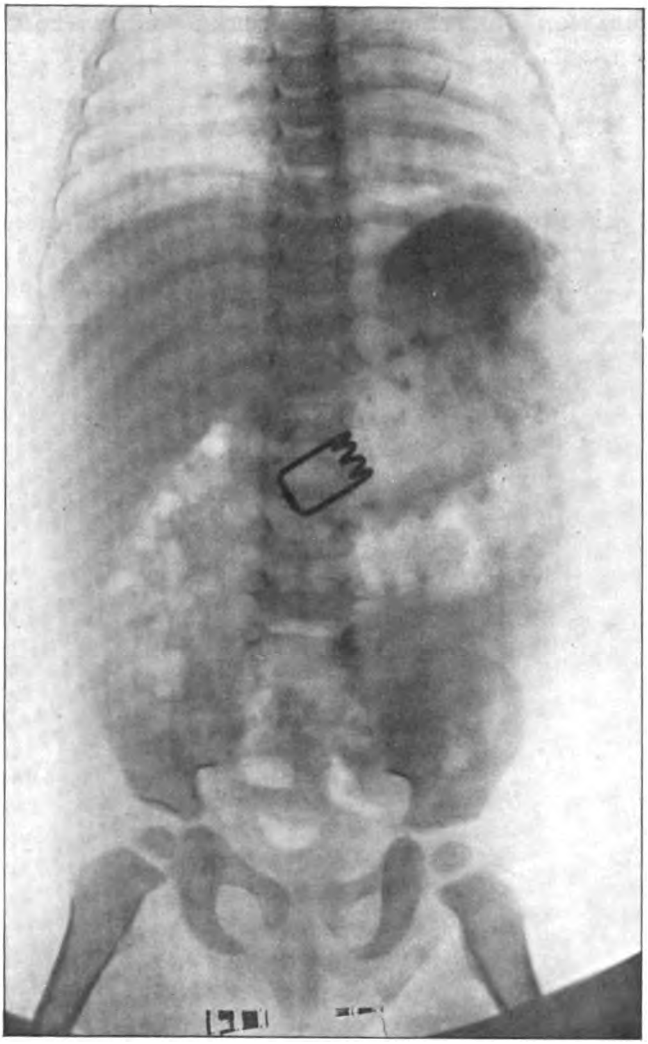
The mother was instructed to bring the child up again on the following morning, and again the spring was found to be lying in the pyloric end of the stomach. It was quite movable (see fig.).

The infant looked well and happy, and apparently was free from any symptoms of discomfort.

The surgeon who was called in consultation was of opinion that there was a possible but very remote chance of the spring passing through the extremely small pylorus of a child of that age, on account of its size

and very irregular shape, its position, and the fact that it was still present in the stomach three days after ingestion.

He advised a gastrotomy, and all arrangements were made for this to take place on the next morning at the Families' Hospital, Abbassia, some ten miles away.



At 8.45 a.m., a telephone message was received to the effect that the spring had just been passed *per vias naturales*, and it will thus be seen that the foreign body, after having been held up at the pylorus for seventy-two hours, had passed out of the stomach, and been evacuated in a period of about twenty hours.

In view of the distance of the Families' Hospital from the Radiological Unit, the inadvisability of transporting a child such a distance

immediately prior to an operation, and the certainty which was felt that this foreign body might not pass through the pylorus, no further X-ray examination had been contemplated.

This little patient was extremely fortunate to have escaped a laparotomy which might have been attended with grave risks in so young a child.

MORAL.—NEVER OMIT AN X-RAY EXAMINATION IMMEDIATELY PRIOR TO ANY OPERATION FOR THE REMOVAL OF A FOREIGN BODY FROM THE INTESTINAL TRACT.

"HOIST WITH HIS OWN PETARD."

By MAJOR H. J. RICE,
Indian Medical Service.

WERE I asked to say what is one of the most difficult cases to diagnose in medicine, I would unhesitatingly suggest "malingering."

We must have all, at some time or other, met the individual with vague

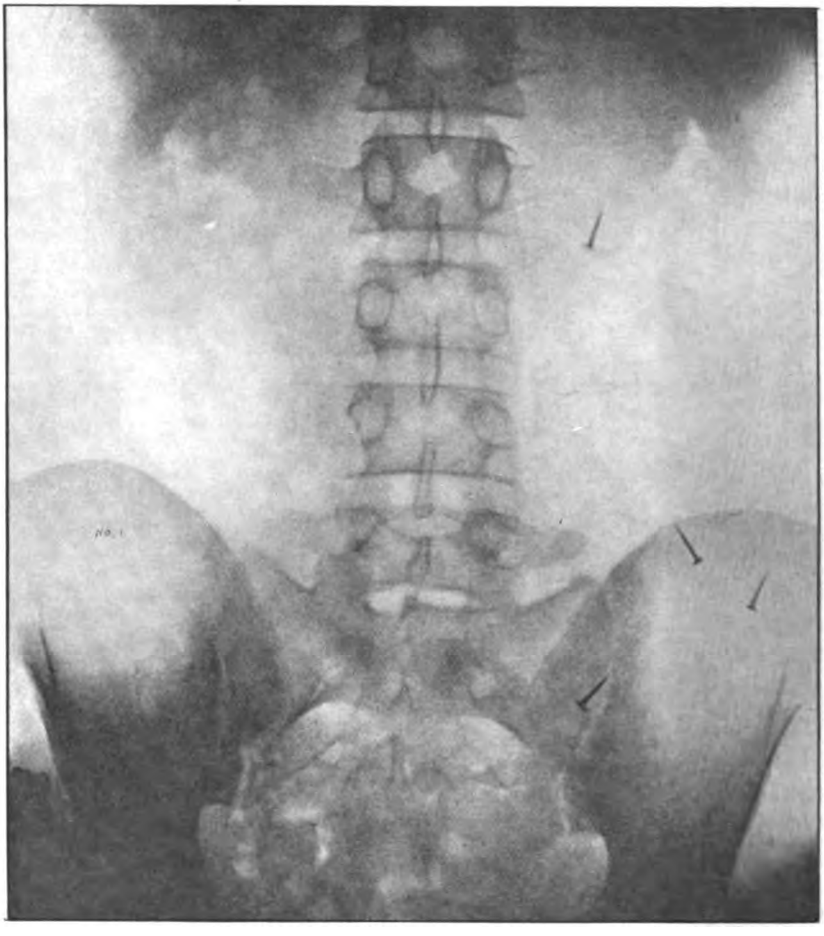


FIG. 1.

muscular and abdominal symptoms and pains whom we strongly suspect to be exponent of the gentle art of "lead-swinging." Yet it requires more than a strong suspicion to swear away a man's liberty. If only an individual is modest with his symptoms, invents a pain in a reasonable place and *sticks to his statement*, what a thorn he can be in the side of his regimental medical officer.

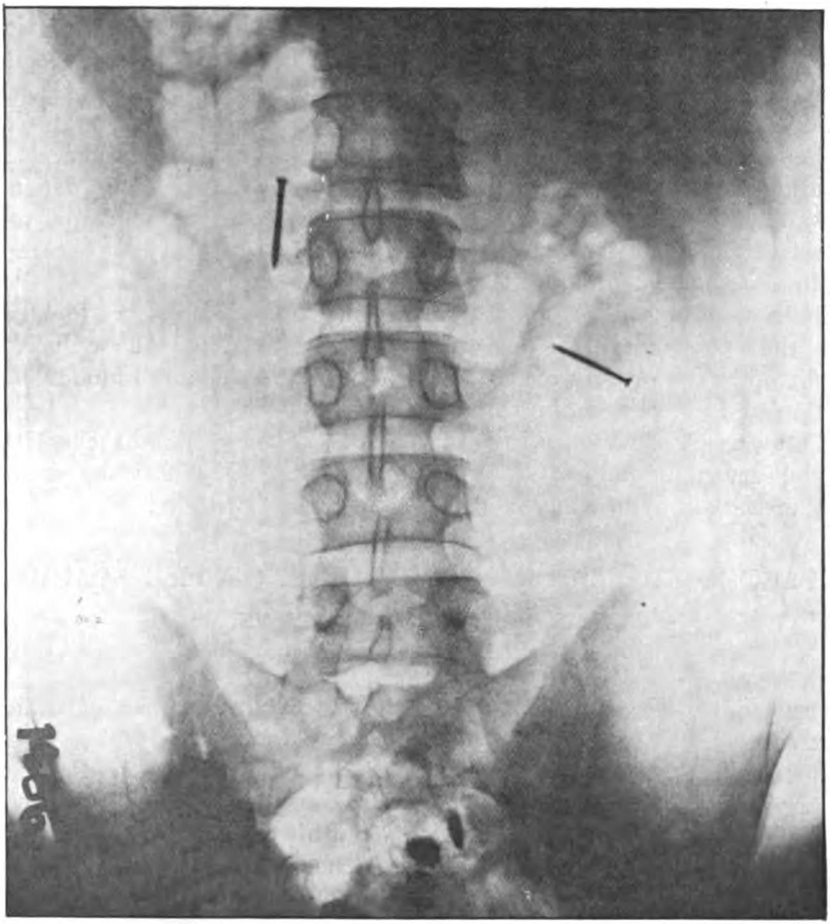


FIG. 2.

The two radiograms reproduced illustrate a rare case where radiographic evidence of malingering was made available by the man's own crude attempt to "paint the lily."

Sepoy X was admitted to hospital. He gave a history of having been put on a fatigue which involved the use of a hammer and tacks. The latter, in time-honoured fashion, he placed in his mouth. Under the stress of some sudden emotion, down went the tacks! "A handful of them," the patient explained, with quite an air of achievement.

He was duly admitted and X-rayed. The radiogram (No. 1) revealed four tacks, with nasty sharp points, in the region of the cæcum. The surgically minded sharpened their scalpels ready for the worst, whilst those on the medical side plied their bread and butter, cotton wool and optimism. Eventually, two tacks reached their journey's end. Of the remaining two there was no sign, in spite of the unceasing vigilance of a lynx-eyed attendant.

After a reasonable period of waiting, it was decided, in the patient's hearing, to have another radiogram taken. The result, to say the least, was startling, *vide* fig. No. 2. Instead of the expected two small tacks, two one-inch nails were discovered in the transverse colon.

The conclusion drawn was pretty obvious. Having evacuated the remaining tacks in some surreptitious fashion, he remedied the deficiency by swallowing the best substitute available. Flattering no doubt to the comfort of the hospital where he hoped to prolong his stay, but scarcely a compliment to the acumen of the radiologist!

The nails eventually reached their destination. I am sorry to have to relate that this story has not a happy ending. When the culprit was brought up in the orderly room his C.O. refused to see any humour in the situation and consigned him to prison.

It may be asked why, having obtained two of the original tacks without being observed, did he not swallow them again? My only suggestion is that there is a limit to what even "lead-swingers" will do!

IMPACTED FRACTURE OF THE NECK OF THE SCAPULA.

By Major C. A. HUTCHINSON,
Royal Army Medical Corps,

The following case would appear to offer certain features of sufficient interest to warrant its publication in the Corps Journal.

Fusilier J. B., 1st R. Fusiliers, aged 21, was admitted to the Connaught Military Hospital, Poona, on March 13, 1933, with the following history:—

On two previous occasions he had broken his right humerus.

About twelve months before admission he was struck, when boxing at his station, Ahmednagar, behind the point of the right shoulder, and the humeral head was dislocated.

According to him it was reduced by an orderly; he was given one week's excused duty and then returned to duty quite all right.

About three months before admission to hospital he was charged, while playing football, and fell striking the point of his right shoulder on the ground. The humeral head was again dislocated.

He was taken to Ahmednagar hospital, where the dislocation was reduced by an Assistant Surgeon.

He remained in hospital there for one week, and was then transferred to the Connaught Hospital, Poona, for massage and X-ray examination.

Here he remained for one week, and then went out to one week's "excused duty." He was then again apparently all right.

On March 12 he miskicked a ball at football and fell on his outstretched hand. He heard a click, and fainted from the pain in his shoulder, which had been again dislocated.

He was admitted to Ahmednagar hospital, where the dislocation was reduced under an anæsthetic.

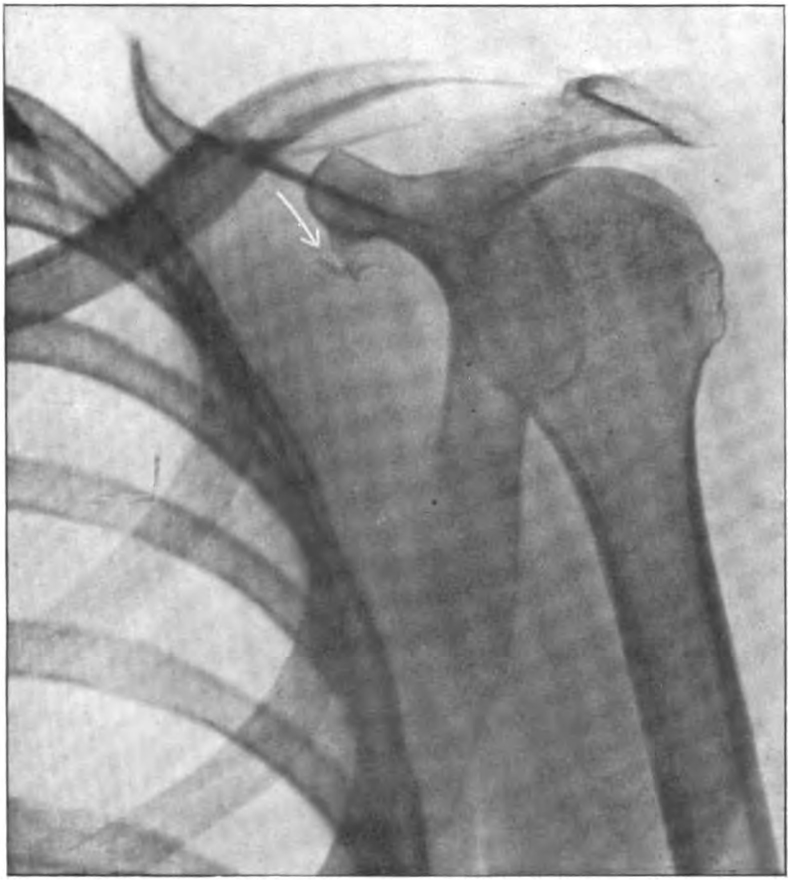


Fig. 1.

He remained there one week, and was again transferred to the Connaught Hospital, Poona, for X-ray examination and massage.

I examined him on admission and found the following condition :—

There was very little swelling, no obvious deformity, no crepitus, no localized tenderness; the shoulder movements were, however, limited, especially internal rotation and upward extension (both of which were markedly reduced).

He was X-rayed first with the arm by the side, when a line of fracture was seen, apparently through the base of the coracoid process. (*Vide* fig. 1).

In view of the marked limitation of movement, it was difficult to believe that this could be the only lesion; accordingly a second X-ray was taken, this time with the arm out at almost right angles with the thorax; then a line of fracture was seen through the scapular neck, with two displaced fragments close to the fracture line. (*Vide* fig. 2.)

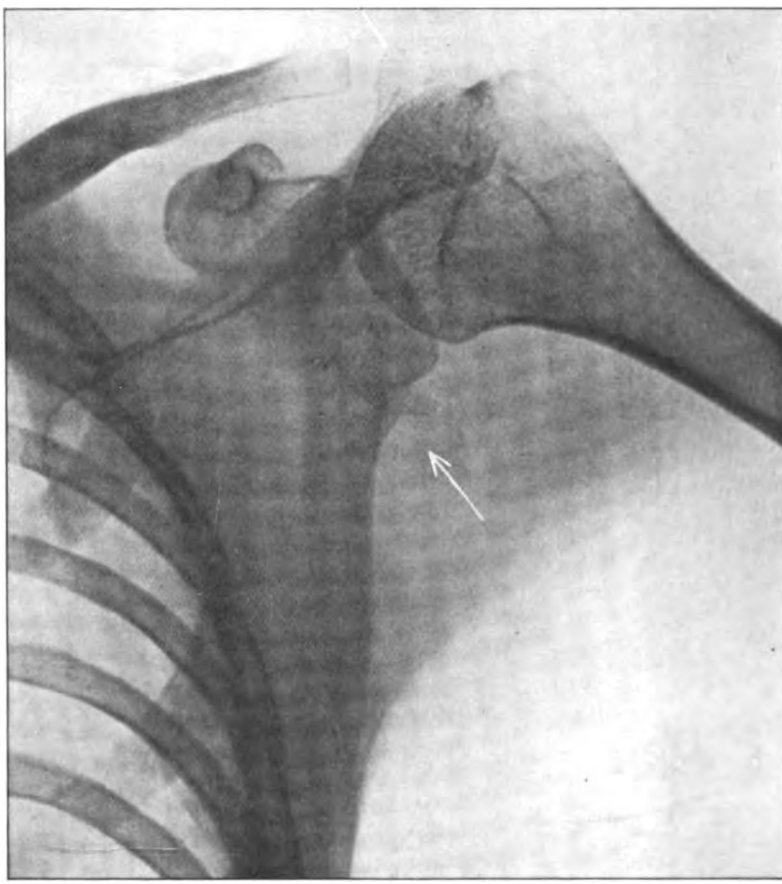


FIG. 2.

Further examination showed that the scapula moved as a whole; and accordingly it was possible to make a diagnosis of impacted fracture.

Treatment by massage and movements was instituted, with the result that the patient had regained almost complete shoulder movements within a month when he was discharged from the Connaught Hospital.

It is thought that the following points are of interest:—

(1) The association of such a rare lesion as "impacted fracture" of the

neck of the scapula with that other uncommon lesion "recurrent dislocation" of the humeral head.

(2) The good recovery of function obtainable with massage and movements after a severe lesion of this nature, and that, too, in a comparatively brief space of time.

(3) Lastly, this case would appear to bring out the importance of X-ray examination both with the arm by the side and out at right angles to the thorax in any case where there is marked limitation of shoulder movements.

I am indebted to Lieutenant-Colonel H. H. A. Emerson, D.S.O., R.A.M.C., commanding the Connaught Hospital, Poona, for permission to forward these notes for publication, and to Major H. J. Rice, M.C., I.M.S., for the radiograms and the supervision of the treatment.

Travel.

SUGGESTIONS AS TO THE CHEAPEST METHODS OF SHOOTING TIGER IN THE CENTRAL PROVINCES, INDIA.

By EXILE.

This article is in no way intended to deal with the art of big game-shooting, for that we should refer to Stewart, Best, Dunbar-Brander and others. It is solely intended for the novice who is dependent upon his pay and who wishes to make the best possible use of his leave. Others, too, who suffer from a club bill might profit by a month away from the station. At the end of nearly every book on shikar there is usually a chapter devoted to equipment and to expense. Were this chapter to be placed at the beginning it is doubtful if many of us would read further. The output is devastating and quite beyond the average subaltern's pay. But if tackled rationally a month's leave for two people should not cost more than Rs.400 per head and very often less. A shoot as planned here cuts luxury down to a minimum, and may go so far as to make the question of meat dependent upon what is shot for the pot, as it is tinned foods which cost so much, so they must be avoided where possible.

The following suggestions are naturally open to criticism and possibly only justify themselves in that several successful leaves have been spent on the lines laid down here. Big game shooting as done by the average young officer in India is not an expensive sport, or should not be, when he knows the ropes. It is in the hope of saving a beginner from buying experience that these notes have been put together. No apology is therefore made for some very elementary observations.

There are several recognized methods of killing tiger, and by far the most exciting and most sporting is of course by beating. But unless one

is lucky in the particular type of country, beats are costly affairs and can only be indulged in on somewhat rare occasions. For most shooting one must therefore rely on sitting up over kills or live baits.

Just after writing the above there was a slight discussion with a friend who maintained that no tiger was worth shooting except on foot. The suggestion was that anybody could sit up a tree, well out of danger, and shoot a tiger. That is all very well, but it would seem that there is no more immediate danger from shooting tiger on the ground than in a tree. Unless one is silly enough to shoot at a tiger head-on there is very little danger. There are only three occasions when animals are dangerous (this does not apply to bear), when wounded, when females with cubs, and when suddenly startled. If this statement is accepted it would seem that it matters very little where the initial shot is fired from.

Occasionally one may have the good luck to meet tiger in the daytime bathing in a pool or lying up under a shady tree. Monkeys have been the downfall of many a tiger and panther shot in daylight. They will spot him however well concealed he may be, and in their excitement and fright will kick up a row that can be heard all over the jungle. It is a happy chance if one happens to be in the vicinity. In any case where monkeys chatter or a sambhur bells it is always worth while to investigate.

The duties of forest officers may not be generally known and are worth while mentioning. From a forestry point of view India is split up into various districts, e.g., Nimar District, Hoshangabad, Mandla, and hundreds of others. Each district is presided over by a Divisional Forest Officer (D.F.O.), who divides his district into several areas over each of which he places a Forest Officer (F.O.) in sub-charge. The F.O. likewise divides his country in still smaller areas in charge of which he places a Range Officer (R.O.). These smallest divisions are known as BLOCKS and a R.O. may be responsible for two or three of them. A Divisional Forest Officer may or may not be an Englishman. The F.O. is usually Indian or Eurasian, but should speak English well and is usually in a position to make or mar your shoot. The R.O. too can be most helpful.

It is usual to reserve one or two blocks for the leave. If the names of the blocks are known apply to the D.F.O. for them, otherwise tell him what you want to shoot and ask him to recommend a suitable one. A block cannot be reserved for more than three months ahead. In applying you must also give the name of anybody accompanying you. The cost of a block in the Central Province is Rs. 20 per month and must be paid for by money order. Having done all this ask the D.F.O. for the numbers of the necessary maps (one inch to mile or bigger), and get them from Map Survey, Wood Street, Calcutta. At the same time get in touch with the F.O. giving him an outline of your plans to see if he can improve on them. Ask the proper price to pay for small buffaloes (usually Rs. 4 to Rs. 7) and if there is likely to be any difficulty in procuring them. Ask, too, if you can be provided with a forest guard. The guard is a forest policeman and most

useful if there is any trouble with the coolies or difficulty in getting eggs, etc. But as he costs money, Rs. 1 per day, he must be regarded as a decided luxury.

The next all-important point is the question of a heavy rifle, and whatever calibre the rifle may be it must be double-barrelled. It is asking for trouble both for yourself and for others if you ever use anything else. This sweeping statement does not apply when walking up a wounded animal, where a 12-bore with lethal or L.G. is invaluble. There has been a lot of argument as to what bore a rifle should be, but for soft-skinned animals a 0·500 Express is as good as any. Such a weapon is an expensive thing either second-hand or new, but luckily it is fairly easy to borrow. A borrowed rifle should always be tried out thoroughly on the range before leaving the station. A friend of mine once lost a very good panther in daylight because his safety-catch jammed. The panther was lying along the branch of a tree taking very little notice of anything. Another very important point sometimes forgotten is to see that the torch and clip fit the rifle so as to focus well on the foresight; a battery fitter or armourer-serjeant can very soon make any necessary alterations. As regards the torch clip, many ingenious varieties have been invented but by far the cheapest and best can be obtained from the Army and Navy Stores, Bombay. It consists of two double-curved pieces of metal joined towards one end by a screw. The smaller arms fit on the left barrel just beyond the handpiece while the larger arms circle the torch. With the thumb on the switch the hand will encircle the torch and barrels.

Remember that when you switch your lights on to an animal you have loads of time in which to aim and fire. Animals invariably look up at once and all that is visible at first is a pair of eyes. Provided you make no noise he will either go on looking indefinitely or go on with his meal. There are many instances of firing too soon, and hyænas have been killed in mistake for tigers. One man I knew went as far as to kill his own goat, but he was on his honeymoon. Remember, too, that your back sight is a little difficult to see, and that the tendency is to fire high. So much for the heavy rifle.

A light buck rifle is usually taken by most people, but is by no means an essential. It is certainly easier to carry, but a heavy rifle will do the work just the same and has the advantage that should bigger stuff be accidently met with it will serve its purpose.

A 0·22 rifle is an absolute essential. It is practically noiseless and will kill a peafowl or even a chinkara at 100 yards. Some people maintain that an occasional shot from a twelve-bore gun will not disturb tiger in the vicinity. I am morally certain that I have lost one tiger from it and strongly condemn it. A peafowl beat is the best fun in the world, but do it just before you move on.

Personnel.—Personnel in camp will consist of the following :—

One water carrier at six annas per day. Apart from carting water he

also does all the dirty work of the camp and his life in general is made a hell by everybody. Drinking water must always be boiled and unless personally superintended you can be pretty sure it is never properly done. After boiling the water is run off into the packal for storage and the six chagals are replenished from the packal. It is astonishing how cool the water will keep in a chagal even on the hottest of days.

Boda men at six annas per day, one for each buffalo (boda), the stock of these should not be allowed to fall below four until leave is nearly over. Their job is to water and feed the boda and to tie him up for bait. The animal is usually a pitiful specimen and contrives to live on grass. He should invariably be tied up by one leg and never by the neck or he will probably strangle himself. The rope need not be tied unpleasantly tight as the boda is far too lazy to attempt to get away, nor need it be so short as to give him very little range of movement. This latter is a very common fault with natives. Having watered and tied him up, see that he has lots of grass with which to amuse himself during the night. To my mind there is no cruelty in tying up such an animal, he is too lethargic to know such a thing as fear and his death is a very instantaneous affair. (Goats are of a very different temperament.)

Gun bearers, one for each sahib at 8 annas per day. The term shikari has been purposely avoided as in the Central Provinces one should be one's own shikari. Many of the villagers will advertise themselves as "bahout attchca" shikaris. They may be, but look round for an intelligent youngster who knows the jungle and who will do what he is told. Impress upon him that he is not a shikari, and that you are running the show yourself. It will soon be found that he knows the jungle as well as anybody and also the usual tiger haunts. In fact he knows just as much as any shikari and what is more he is young and keen. Reliability must be his one virtue, so above all avoid the hot air merchant with whom the jungle abounds more than most places.

Beaters should be content with four annas per day. How many are required depends entirely on the country. I just missed seeing one tiger killed when an officer's wife, two bearers, two boatmen and one water carrier beat out the tiger from the banks of the Nerbudda River from boats. This I should think might be a record.

Professional skinners are not necessary and if employed are very expensive. With the help of Van Ingen's book on the subject skinning is made comparatively easy.

You will have to do all the difficult parts yourself, e.g., ears, lips, eyes, etc., but otherwise the camp followers are only too willing to lend a hand with the coarse cleaning. It is not essential to keep a skin "pegged out." Possibly you may collect a skin the day before moving camp and do not want to postpone the move for three or four days. In those circumstances having cleaned the skin, all that is necessary is to rub equal parts of salt and alum well into the skin and fold it up with the hair outside.

Salt and alum must be applied daily until the skin is as hard as a board when it will keep indefinitely. These remarks do not seem to apply to mugger hides as the tannery companies prefer to receive them damp and soft. I once sent two mugger hides to a tannery company only to have them returned within a week because they were as hard as boards and nothing could be done with them. We then deposited these skins in the mali pond for a couple of days and sent them off to the same company. A satisfactory report was returned, and in time the required articles were received beautifully made up.

One of the major expenses is in carting kit by rail; but if stationed within 150 miles of the block this should not cost more than Rs. 40 or Rs. 50. It is very often possible to motor straight into the middle of the jungle in a very few hours, whereas it may take a couple of days to get there by train and bullock cart. It is far more comfortable to send servants and kit on in advance so as to find the camp pitched on arrival.

The usual rate of pay for bullock carts is about Rs. 2 per day per cart. They are naturally only required when camp is moved, and four should be the maximum number necessary. It is always best to march at night, unless the march is under eight miles. In the heat of the day the wretched little bodas being beaten along behind are apt to die from exhaustion, and the bullocks themselves have a very thin time. Their average pace is $2\frac{1}{2}$ miles per hour, and they are very tedious things to march with. It is better to give them a good start or even let them do the whole distance and unload. In addition, they make such a row that all game will flee before them.

Everyone has his own idea as to what a machan should be. Some prefer an ordinary stretcher, which in my mind is quite the most uncomfortable thing in the world, others advocate the ordinary village charpoy. The latter is very satisfactory and comfortable, provided it is free of bugs. It should be well soaked in water before use so as not to squeak. It should be tied in the tree upside down, that is to say, with its four legs skywards. These can then be utilized by tying strings across them and sticking small branches of the tree through the string in order to camouflage the charpoy. But be sure the branches so used come from the same tree. Natives are pretty good at tying up a machan, but you must always be present to tell them exactly which way it must face, and also to make certain they are not building it over an ant's nest. A machan should be placed at right angles to the kill, so that by lying on your back with the rifle by your right side you can sit up quite quietly, use your left knee as a rest, and fire down over the left side of the machan. This is by far the most comfortable and noiseless position to adopt, as you may have to lie there fourteen or fifteen hours on end. Another very useful machan can be made by fashioning a length of lead piping into a rectangle over the required area, and then sewing lengths of webbing to it, so that the lengths interlace with one another. This variety is absolutely noiseless.

Equipment. 1.

Rifle	1 heavy, double barrel	
Rifle	1 light, single barrel	
Rifle	1 0·22	
Gun	1 twelve bore	
Torch with spare batteries and bulbs		
Torch clip		
Rope, stout	40 feet, for machan tying	
String, stout	40 feet	
Rope ladders	2	
G.S. head ropes	12 (for tying up)	
Tents, 160 lb.	2 for selves	These can be borrowed from almost any unit
Tent, 160 lb.	1 for servants	
Tent, 80 lb.	1 for skins	
Canvas water buckets	4	
Packal	1	
Chagals	6	
Kerosin oil tins	2 (for bath water)	
Oil drum	1 (for boiling drinking water)	
G.S. water bottles	4	
Lamps, hurricane	3	
Lamps, petronax	1 (with spare mantles and glass)	
Table, folding	1	These can be hired for Rs. 2 per month
Chairs, folding	2	
Chairs, canvas	2	
Camp beds	2	
Mosquito nets	2	
Basins, canvas	2	
Baths, canvas	2	
Bicycles	2	
Petrol tins	2	
Haversacks, I.P.	2	
Cutlery		Can usually be borrowed from a Unit
Cooking utensils		

Stores. 2.

Tea	6 lb.	Cocoa	3 tins
Jam	4 lb.	Dripping	6 tins
Marmalade	2 lb.	Spice	1 tin
Baking powder	2 tins	Sunlight soap	1 box
Custard powder	2 tins	Dahl	10 lb.
Milk	40 tins (small)	Sardines	4 tins
Herring in tomato	2 tins	Flour	40 lb.
Corned beef	6 tins	Rice	30 lb.
Matches	4 dozen	Atta	50 lb.
Candles	1 packet	Sugar	50 lb.
Worcester sauce	2 bottles	Potatoes	130 lb.
Vinegar, C. & B.	2 bottles	Onions	30 lb.
Mustard	1 tin	Dried fruit	25 lb.
Pepper	1 bottle	Sultanas	1 lb.
Salt, Cerebos	1 tin	Currants	1 lb.
Golden syrup	3 tins	Bromo	1 packet
Butter	10 tins	Whisky	
Curry powder	2 tins	Cigarettes	
Vanilla essence	1 bottle		

For Skins. 3.

Rock salt	10 lb.	Knives, clasp	2
Alum	10 lb.	Cut-throat razor	2
Pure carbolic	1 oz.	Safety razor blades	1
Nails, 4-inch	4 dozen	Whetstone	1
Hammer	1		

MEDICINES. 4.

Quinine	200 5-gr. tablets	Wool	1 lb.
Iodine	1 bottle	Pot. permanganate	1 oz.
Castor oil	12 oz.	Brandy	1 bottle
Bandages	6	Chlorodyne	1 oz.
Lint	1 roll	Chloride of lime	½ lb.

PERSONAL EQUIPMENT. 5.

Khaki shorts	3 pairs	Can all be washed in local river or pond
Khaki shirts	3	
Pyjamas	2 pairs	
Socks, Army	4 pairs	
Sweater, woollen	1	
Shoes, crepe rubber	2 pairs (New*)	
Topee	1 spare Topee between two people is useful	
Books		
Towels and bedding, &c.		

* It is far more comfortable and also makes less sound to walk through the jungle in crepe shoes and thick socks rather than in heavy boots. In order to keep as cool as possible, the shirt should always be worn outside the shorts.

Money.—Rs.200 each " gun " all in small change.

All money must be taken in the form of Rs.1, 8-anna, 4-anna, 2-anna, and 1-anna pieces. Natives will not have anything to do with paper money. Never pay in advance, but always on the nail, although it should not be necessary to pay wages more often than every third or fourth day. A very careful check should always be kept on your pay roll, as everybody would like to be paid twice.

One word about buck or deer skins. One is always rather apt to have them cured and strewn all over the bungalow floor. Except chetal none of them is in the least ornamental. A decent sized sambhur when tanned will produce ten pairs of shoes, and a buck three or four pairs.

Rewards.—The figures below are subject to variation according to the amount of help any particular man may have afforded.

Tiger	Gun Bearer—Rs. 20 *Boda Man—Rs. 5
Panther, Bear	Gun Bearer—Rs. 5
Sambhur, Chetal	Gun Bearer—Rs. 3

* The Boda Man always thinks that it was entirely through him that his boda was killed, and is terribly proud of himself.

Current Literature.

AMERICAN PUBLIC HEALTH ASSOCIATION YEAR BOOK, 1932-1933. (*Supp. Amer. J. Pub. Health*, 1933, v. 23, June, 40-49). **Swimming Pools and Bathing Places.** [Report of Joint Committee on Bathing Places of the American Public Health Association and Conference of State Sanitary Engineers, W. J. SCOTT, Chairman].

Recent developments indicate that the use of ammonia and chlorine for swimming-pool disinfection will become increasingly popular because of the more lasting disinfecting effect of the process and because higher concentrations of chlorine can be used without irritating effects on the bathers. With chlorine alone more satisfactory results than hitherto can be obtained by maintaining the pH of the water on the alkaline side ; there is less loss of chlorine, less trouble with chlorine odours and less irritation of the eyes of bathers. For the prevention of ringworm infection, particularly of the feet, the use of a chlorine solution as a foot wash has apparently been useful. Sodium thiosulphate has also been reported to be effective for the same purpose, but being a dechlorinator should be used only after bathing in those baths where chlorine is used to disinfect the water. Pipe cross-connections have given rise to some anxiety for there is a danger of pollution of the potable water supply if the latter is connected directly at any point with the re-circulation system of the swimming pool. There is likewise danger of gross pollution of the swimming bath if, as in instances recorded, the drain valves of the bath were opened against pressure which had developed due to overload of the city sewers, and sewage actually backed up into the pools. Outdoor bathing places along small streams, rivers, lakes and tidal waters have been investigated and it is concluded that increasing attention must be devoted to the sanitation of such places, many of which appear to constitute a distinct health menace. The report stresses this important point, viz., "a great deal of uncertainty exists as to the relative public health dangers from swimming pools and bathing places in the way of spread of intestinal, respiratory and skin infections." There is a dearth of epidemiological data on such dangers and it is recommended that an extensive study of the subject should be made jointly by medical experts and laboratory workers.

M. E. DELAFIELD.

Reprinted from "Bulletin of Hygiene," Vol. 8, No. 9.

WILLIAMS, C. L. **Fumigation of Foodstuffs. Public Health Aspects of an Increasing Commercial Practice.** *Amer. J. Pub. Health.* 1933, v. 23, 561-6.

The practice of the fumigation of foodstuffs in order to destroy vermin that infest foods and cause economic loss is increasing at a very rapid rate.

Although there is hardly any direct or specific public health purpose involved in fumigation, it is important to study the possibility that the consumption of fumigated foods may cause injury to health. Two principal processes are used: (1) Fumigation at atmospheric pressure; (2) in a vacuum chamber. The gases chiefly used are hydrocyanic acid, cyanogen chloride, carbon bi-sulphide, ethylene oxide, ethylene dichloride and chloropicrin. These gases are absorbed by the food and to a certain slight extent may actually combine with constituents of the food, as for instance in the combination of hydrocyanic acid with levulose and the combination of ethylene oxide with water to form ethylene glycol.

The fumigant absorbed may become a hazard in two ways. If the food is stored in a closed space, the fumigant is slowly evolved and may produce a lethal or toxic concentration in the atmosphere of the storage chamber. There have been recorded a number of fatalities from gas thus released. The other possible hazard lies in the consumption of fumigated foods but there is as yet no record of any human being ever having been killed by eating fumigated food. Experiments on the feeding of mice, chickens and dogs with foods recently fumigated with hydrocyanic acid have revealed no toxic effect.

Fumigators frequently consume foods which have just been exposed to the same gas, without any ill-effect. The fatal dose of hydrocyanic acid is generally placed at about 60 milligrammes, and 100 p.p.m. of hydrocyanic acid appear in foods fumigated by the vacuum process; it would, therefore, be necessary to consume 600 grammes of such recently fumigated food to ingest the lethal dose. A fatal result is unlikely even if this large quantity of one food were swallowed, for the rate of absorption of the poison, in the presence of so large a bulk of food in the stomach, would be very slow. The practice of free ventilation of the food for twenty-four hours after fumigation would render the food absolutely safe, with any of the fumigants commonly employed. A further point of importance is that owing to the solubility in water of many of the fumigants it is not advisable to treat moist or liquid foods that would be consumed shortly after treatment. The possibility of chronic or cumulative poisoning should be remembered but at present the danger would appear to be negligible, for the proportion of fumigated foods consumed is quite small.

M. E. Delafield.

Reprinted from "Bulletin of Hygiene," Vol. 8, No. 9.

Smith, W., Andrewes, C. H. and Laidlaw, P. P. **A Virus obtained from Influenza Patients**. *Lancet*, 1933, July 8, 66-8, 2 figs.

In this important communication the authors record a series of experiments that seem likely to mark the opening of a new, and perhaps of a decisive, stage in the study of influenza in man. The evidence at present available—for this is a preliminary communication only—may be very shortly summarized.

Throat washings from cases of influenza in the acute stage, after filtration through a collodion membrane with an average pore size of $0{\cdot}6\mu$, have produced a characteristic disease when instilled into the nose of ferrets. This disease is characterized by a diphasic temperature response with a sharp peak about forty-eight hours after infection and a second, lower peak, on the fourth or fifth day. This febrile response is associated with lethargy and weakness, and with symptoms and signs of nasal catarrh that usually commence about the third day. Throat washings from eight cases diagnosed as influenza have been tested in this way; five of these produced the ferret disease. From one of these cases throat washings on the first and second day and the nasal discharge on the third day produced the disease in ferrets, while the nasal discharge on the sixth day proved to be non-infective. A filtrate prepared from the lung tissue of a fatal case of influenzal pneumonia also produced the typical disease. Throat washings from four persons not suffering from influenza were non-infective, although two of these persons had recovered from an attack of the disease during which active filtrates had been obtained. The nasal washings of a person who was suffering from a severe common cold were non-infective.

The virus can be passed in series from ferret to ferret by nasal instillation of a suspension from the ground-up turbinates of an infected animal, or of a filtrate from such a suspension. It cannot, apparently, be passed successfully by any other route. The disease is, however, naturally contagious, and has frequently been transmitted by exposing a normal to an infected ferret for twenty-four hours.

Ferrets that have recovered from the disease have proved to be resistant to reinfection up to a period of five or six weeks. One of two ferrets tested after a period of three months proved to be solidly immune, the other developed a mild attack of the disease with prompt recovery. The serum of a ferret that has recovered from the disease will neutralize the virus if serum and virus are mixed together before injection. Serum from normal ferrets has no such power. Sera obtained from ten human patients after recovery from influenza neutralized the virus; but this neutralizing power appeared to be inconstant, since two of the sera when re-tested failed to protect the experimental animals. Three samples of serum were obtained from persons with no recent history of influenza. One neutralized the virus, the other two did not.

A virus that causes, in association with a hæmophilic bacillus, an influenza-like disease in swine has recently been described by Shope (see this *Bulletin*, 1933, vol. 8, 157). The authors received a strain of this virus and found that it produced in ferrets a disease indistinguishable from that produced by the human influenzal virus, though the disease in the ferret was not modified by the simultaneous introduction of the hæmophilic bacillus. The antigenic relationship of the two viruses was demonstrated by showing that ferrets after recovery from infection with the swine virus

were completely resistant to the human virus, though ferrets after recovery from infection with the human virus were not completely resistant to the swine virus.

W. W. C. TOPLEY.

Reprinted from "Bulletin of Hygiene," Vol. 8, *No.* 10.

Reviews.

THE MEDICAL ANNUAL, 1933. By Carey F. Coombs, M.D., F.R.C.P., and A. Rendle Short, M.D., B.S., B.Sc., F.R.C.S. Bristol: John Wright and Sons, Ltd. London: Simpkins Marshall, Ltd. Pp. cix + 626. Price 20s.

The modern doctor be he physician or surgeon is truly in need of a sheet anchor—some authoritative work within the covers of which he can escape from the perfect flood of medical literature, good, bad, or merely silly, which besets him on all sides. Fortunately we still possess our "Annual" in which we can be sure that no modern method of investigation, treatment, or operation (so long as it has merit), will escape notice. Not only are we sure of finding it, but we have the advantage of its critical review by some recognized authority on the particular subject to which it refers. It is impossible to review in any detail such a work; it now has its recognized place in English medical literature, and it is sufficient to say that if one were confined to the choice of one work alone in order to keep abreast of medical science that choice would assuredly fall on the "Annual."

The present volume fully maintains the high excellence of its past standards and contains either articles by, or reference to the work of, the great majority of notable figures in contemporary medicine.

We know of few better investments for "the pound sterling."

J. H.-S.

THE SANITARY INSPECTOR'S HANDBOOK. By Henry H. Clay, F.R.S.I., F.I.S.E. London: H. K. Lewis and Co. 1933. Pp. xx + 386. Price 15s. net.

This book has been written to replace the last edition of the much-prized Taylor, so long familiar to students working for the sanitary inspector's qualifications.

Throughout, it bears evidence of the author's wide knowledge and experience of the duties of a sanitary inspector in our complex modern life.

The book is well planned, and for a work of the kind remarkably easy to read, even the parts dealing with law being, by the excellent arrangement, welded into an interesting and concrete story.

The facts are stated briefly, clearly and accurately, while the line drawings with which the book is illustrated are extremely clear and likely to be of great value to the student.

Criticism of such a carefully compiled work appears to be only possible on the grounds of the omission of items of information which would appear to be of sufficient importance to warrant inclusion or to deserve more extensive notice. For instance, a bare mention is made of the ammonia-chlorine method of water purification. With the increasingly rapid spread of this method it would seem desirable to go into greater detail regarding its application and the types of apparatus used.

Again in the chapter on Disinfection no indication is given of the possibility of adopting "Downward Displacement Current Steam," a method that has been proved capable of effective use with inexpensive and rapidly improvised apparatus.

In the chapter on Disinfection, when discussing the use of hydrogen cyanide the author omits to point out the desirability of the use of gas masks by the staff employed.

Perhaps in a future edition Mr. Clay will see his way to remedy such omissions. In the meantime he has succeeded in writing an excellent book which meets the needs of the student of to-day perhaps even better than was done by its predecessor in the period to which it belonged.

G. S. W.

Colds and Hay Fever. By Frank Coke, F.R.C.S. London: Baillière, Tindall and Cox. 1933. Pp. x + 148. Price 5s.

This little volume, the most recent addition to the Minor Monograph Series, deals with a number of types of rhinitis or sneezing as seen in general practice.

After a chapter describing the normal structure and functions of the nose, we have others on the Common Cold, Hay Fever, Other Allergic Causes of Sneezing, Paroxysmal Rhinitis, and Chronic Nasal Catarrh. Descriptions of the various conditions are accompanied by very practical directions for their treatment.

While every page bears evidence of the personal experiences of the writer and enunciates his views, there are many references to the works and opinions of others. It is a pleasantly written book and will well repay study.

A Pocket Medical Dictionary. Compiled by Lois Oakes, S.R.N., D.N.Lond. and Leeds, assisted by Thos. B. Davie, B.A., M.D.Liverpool, M.R.C.P.Lond. Edinburgh: E. and S. Livingstone. 1933. Pp. xx + 351. Price 3s.

This small book, which in no way pretends to be a complete dictionary, is intended for use by medical students during their first three years of study, and we think the modest claim as to its scope well founded. Not

the least useful parts of the dictionary are the tables of scales, weights and measures, dietaries, historical medical facts, medical abbreviations, etc., which are incorporated.

The dictionary is of a handy size, well printed on good paper and contains a number of illustrations.

POCKET MONOGRAPHS ON PRACTICAL MEDICINE: GENERAL AND CHILD HÆMATOLOGY. By W. M. Feldman, M.D., B.S., M.R.C.P.Lond., F.R.S.Edin. London: John Bale, Sons and Danielsson, Ltd. 1933. Pp. 96. Price 2s. 6d.

This pocket monograph, which is 6½ by 4 by ½ inches in size, and slips with the greatest of ease into the pocket, contains a fund of useful information for the keen practitioner of medicine. Nothing appears to have been omitted, so that, of necessity, each subject is dealt with very briefly but nevertheless very clearly. To give some idea of the scope of this little book, the chemistry of the serum is dealt with in one chapter only, and covers sugar, its metabolism and function, acidosis and lactic acid acidosis, glycolysis, maintenance of sugar equilibrium, hyperglycæmia and hypoglycæmia with symptoms and treatment, tolerance tests, non-protein nitrogen, cholesterol, minerals, bile pigment, Van den Bergh test, etc. There are eight other chapters. The book is intended for the physician, and does not, of course, detail complicated laboratory methods. Normal and abnormal findings in the many examinations now carried out on the blood are given, together with the significance of the latter in diagnosis, prognosis and treatment. It is a most useful little book and very cheap.

H. T. F.

ESSENTIALS OF MEDICAL ELECTRICITY. By E. P. Cumberbatch. Seventh Edition. London: Henry Kimpton. 1933. Pp. 508. Price 10s. 6d.

The full value of the physiotherapy department of a hospital cannot be appreciated unless the clinician has knowledge of the various types, the scope, and the benefit, of available methods of treatment.

Previous editions of this excellent manual are well known to all who specialize in this class of treatment, and to those studying for the Diploma in Electrology it is the standard handbook. The author has brought the book right up to date, and provided full information on the modern machines and methods of electrothermic procedures.

Not the least important feature of the book is its price, and in these times there must be few medical books with such a mine of information at such a low figure. The subject matter can be understood quite readily by those without any special technical knowledge, and they will find in the various chapters and in the Index of Treatment much that will help them in the diagnosis, prognosis and treatment of their patients' complaints.

W. K. M.

Correspondence.

CENTRAL MALARIA LIBRARY, ROME .

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

DEAR SIR,—A malaria library was founded in Rome by the Stazione Sperimentale per la Lotta Antimalarica in 1925, and an "Index to Malaria Literature" is issued annually by the Station.

To make this as complete a central malaria library as possible we appeal to all malariologists to send us books, reports and articles on malaria.

Photostat copies of any articles in the library can be had on request, at the cost of production.

All publications aud requests should be addressed to The Director, Stazione Sperimentale per la Lotta Antimalarica, Corso Vittorio Emanuele 168, Rome (16).

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A. MISSIROLI
(The Director).

Notices.

"TANNAFAX" TANNIC ACID JELLY.

The inconvenience of preparing fresh solutions of tannic acid and the deterioration of the solution when stored have limited its employment as a first-aid treatment for burns.

The precipitation of protein by tannic acid and the subsequent formation of a firm coagulum are prevented by the application of olive oil and grease, the removal of which is necessary before solutions of tannic acid can be effective. This unnecessary and harmful delay may be avoided by the use of "Tannafax" Tannic Acid Jelly. The product is prepared by Burroughs, Wellcome & Co. It is non-oily and non-greasy and has a water-soluble antiseptic base that can be easily bathed off when medical treatment demands the removal of dead tissues.

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ANTI-FLY MEASURES.

The "Twilight Fly Catching Co.," of 105, Station Road, Westcliff-on-Sea, Essex, recently demonstrated, at the Royal Army Medical College, a patented device of British manufacture consisting of a shallow aluminium tray measuring ten inches by eight inches, the edges of which are protected by a sponge rubber strip. A greaseproof "fly-board," coated with specially prepared "tanglefoot," leaving a clear ½ inch margin, is inserted under clips which secure it to the bottom of the tray. The tray can be fitted with an enamelled pole of either four feet or five feet in length according to the height of the surfaces to be dealt with. When sufficient insects have been captured the "fly board" is easily withdrawn and a refill inserted. When not in use, a light cover preserves the "tanglefoot" and screens the victims from view.

The apparatus is simple in construction, cleanly in operation and appears to be a useful addition to the weapons devised to deal with winged insects.

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No. 2. February, 1934. Vol. LXII.

Journal of the Royal Army Medical Corps

ISSUED MONTHLY

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Vol. LXII. February, 1934. No. 2

Journal
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Original Communications.

DIFFICULT DIAGNOSES.

I.—Minor Manifestations of Amœbiasis with a Note on their Diagnosis by the Differential Blood-Count.

By Lieutenant-Colonel J. HEATLY-SPENCER, O.B.E.,
Royal Army Medical Corps.

It is perhaps not even yet fully realized that some of the less severe grades of ill-health which occur in persons who have returned to this country from abroad are due to amœbic infestation which may have been acquired many years before. "That transient disturbance of biological balance between host and parasite," leading in one case to perhaps definite hepatitis, in others to minor grades of illness, may present us with extreme difficulties in correctly estimating its presence and its importance as a factor in the production of symptoms. When the amœbic lesions are confined to the gut there may be encountered certain pitfalls in diagnosis, the knowledge of which is common to every physician in the tropics, but which is still on occasion only acquired through painful mistakes by those who have not the benefit of the wider experience. One now almost classical cause of mistaken diagnosis lies in the very close clinical resemblance which may exist between chronic appendicitis and chronic amœbic cæcitis. Both these conditions may give localized signs and symptoms, both may cause a reflex hyperchlorhydria, and both may be accompanied by a differential blood-count of pathological significance. In such cases as these the usual method of excluding the presence of amœbic infestation is by the examination of one or perhaps even two stools for the presence of entamœbic cysts—a procedure which, in its utter futility, closely rivals that of excluding malaria by the examination of a single blood-film. The discharge of entamœbic cysts in the fæces is apt to be very intermittent, so that prolonged search for them is essential and should always be supplemented by sigmoidoscopic

examination for the possible presence of entamœbic lesions in the lower colon or rectum. We know of cases of amœbic cæcitis which have undergone appendicectomy, but fortunately we have yet to meet the surgeon who would undertake, as treatment of priority, the removal of a quiescent appendix in a patient with demonstrable entamœbic lesions in the sigmoid.

Still further, it does not appear to be generally known that apart from the manifestations of gastric disorder that accompany a definite amœbic hepatitis, the same infestation, while yet confined to the bowel, may cause symptoms suggesting organic disease of the stomach. The writer well remembers such a case, labelled as gastric ulcer, being sent into hospital for treatment of that complaint. It so happened that the patient was known to him as one who had suffered from a non-specific colitis some years before in India. The demonstration of entamœbic cysts in the first stool examined, together with the complete disappearance of gastric symptoms under a course of emetine salts and stovarsol, satisfactorily disposed of the first diagnosis.

It is, however, in those cases in which metastasis to the liver has occurred that interest is mainly centred. We are all too accustomed to think of amœbic hepatitis only as an acute condition which is either cured by drugs or else goes on to abscess which kills or is in turn "cured" by operation. The number of recurrent cases of hepatitis following within a year or two of successful aspiration of tropical liver abscess should warn both physician and sufferer that once metastasis to the liver has occurred a constant watch must be kept, not only for definite signs of hepatitis, but also for those minor manifestations of hepatic derangement which depress the general health and but await an opportunity for development into the acute condition. This precaution should apply most particularly to cases of liver abscess "cured" by operation. What may be called the lesser hepatic cases present the utmost difficulty to the physician in arriving at correct conclusions, for generally none of the usual signs and few of the symptoms of hepatitis are present. The patients complain of a general lack of physical fitness with perhaps at times some vague discomfort in the liver region. These may sometimes more certainly be localized when jarring of the body makes the sensations more acute. There is little to be found by the examining physician; the physical evidence we expect, and rely upon when present, is wanting. Fortunately we have had for some years now a powerful aid to diagnosis in such obscure inflammatory conditions in the Schilling-Torgau differential count, which is a modification of the Arneth index. It is surprising how seldom this test seems to be employed. The count is an easy one to make, and anyone who can stain a blood-film can do it for himself. The Schilling index does *not* pick out amœbiasis and declare it to us; what it does do is to tell us when a pathological condition of the blood secondary to an inflammatory process is, or is not, present. If it can be demonstrated that a person returned from the tropics with vague liver symptoms has an inflammatory process going on in the body, then it is important to take note of it, for graver events may be impending. Let us see how it works in practice.

The first case chosen in illustration is one of definite amœbic hepatitis, for here the condition, both clinical and pathological, is clear and beyond argument.

Case 1.—Admitted with all the classical symptoms and signs of severe hepatitis following one year after successful surgical treatment of tropical liver abscess. These findings included enlargement of the right lobe of the liver, upward displacement of the diaphragm with limitation of respiratory excursion, accompanying signs at the base of the right lung, fever, and a leucocytosis of 21,000 per c.mm.

	I (Normal)	II	III	IV
Total count		21,000	20,400	13,000
Differential	Per cent	Per cent	Per cent	Per cent
Eosinophiles	3	Nil	2	2
Lymphocytes	23	12	15	22
Myelocytes	Nil	Nil	Nil	Nil
Metamyelocytes	Nil	2	1	1
Band forms	4	30	10	6
Polymorphonuclears	63	54	64	64
Large mononuclears and transitionals..	6	2	7	4
Mast-cells	1	—	1	1
	100	100	100	100

The table shows in column I the average normal count in health, and in columns II, III and IV, counts from this case taken on admission and at weekly intervals thereafter.

Placed upon a combination of emetine by injection and full doses of stovarsol by mouth the patient was markedly better and afebrile at the time of the second count (column III), and quite convalescent by the time the last count was made (column IV).

The marked shift to the left in the acute stage (column 2) is illustrated by three main characters in the count—the rise of band form granular cells from a normal of 4 per cent to 30 per cent, the drop in the lymphocytes from 23 to 12 per cent, and the low relative total of polymorphonuclears. One week later the change back to normal has already begun, and by the end of two weeks it is almost complete. Note particularly how the total count lags behind the differential count in the change back to normal conditions. In view of the recovery of the differential count, no anxiety was felt, because the total count still remained at 13,000 in this case. Such a case may be taken as a standard by which comparison with others can be made.

The next case, which is given to illustrate one of those in which diagnosis by physical means is impossible, is that of an officer who was on full duty and remained so throughout the period of investigation and treatment. His complaint was of general unfitness with vague sensations of discomfort in the region of the liver. At times some jarring movement increased this discomfort—that was all. On investigation, nothing was found. There was no demonstrable enlargement of the liver—the right cupola of the diaphragm was steep, but one may see a dozen such

appearances in a short time among people who have never been abroad—certainly there was nothing of pathological import in this X-ray picture. The total leucocyte count was 9,000. With all this negative evidence before us, let us look at his differential count :—

Eosinophiles ...	6	Polymorphonuclears	38
Lymphocytes ...	32	Large mononuclears	4
Metamyelocytes ..	14	Mast cells ...	1
Band forms ...	5		

The significance of this count lies in the presence of 14 per cent of metamyelocytes which are precursors of the band forms of granular leucocytes. Here is then a definitely pathological count indicating the presence of an inflammatory process. The history was one of a tropical diarrhœa some years before—the site of discomfort the liver—the existence of this symptom prolonged over some months. Anti-amœbic measures (much modified to enable him to avoid reporting sick) were applied to this case with distinct improvement of the general health. Two weeks after commencing this treatment his count reads :—

Eosinophils ..	6	Band forms ...	nil
Lymphocytes ...	41·8	Polymorphonuclears	47
Metamyelocytes ...	2·8	Large mononuclears	2·4

In a period of one month the whole of his complaint had disappeared. In his own words he became a thoroughly fit man from having been one who had been constantly below par for a long period.

Regarding these counts it is usually found that the lymphocytes drop to a marked degree, and that recovery of the patient is followed by a compensatory lymphocytosis in which the counts may run to thirty per cent or forty per cent in convalescence. The drop appears to be confined to the more acute type of case. The lymphocytes are not of great significance. What is to be determined is the presence of immature polymorphonuclears either in excessive numbers in band forms, or in the appearance of the definitely pathological earlier forms known as metamyelocytes or myelocytes. Eosinophiles are absent, as a rule, from the count in an acute case, and reappear as improvement sets in. Eosinophilia in persons returned from abroad is a trap for the unwary ; sometimes it means parasitic infestation, often it means nothing, at any rate nothing we can at present explain. Thus a relatively high eosinophile count in these people does not affect the significance of immature neutrophile granular cells.

The short account of these two cases among others (which were worked out some time before Acton recently drew attention to the importance of amœbiasis in relation to many features of ill-health in persons returned from abroad) must suffice for this paper. These cases are numerous and the writer has encountered many in the last few years. There is nothing specific in the application of these counts. All they prove is that a given liver condition either is or is not inflammatory in nature, and they may enable us to choose between treatment by emetine on the one hand and calomel on the other, a somewhat important decision for the patient.

TROOPSHIP TEMPERATURES AND SUGGESTED METHODS OF IMPROVEMENT. INSULATION BY ALUMINIUM FOIL SHEETING.

By Major T. O. THOMPSON,
Royal Army Medical Corps.

On an outward voyage on a "trooper," especially in the Red Sea, the following remarks may frequently be heard :—

"Oh my cabin is so hot; I can hardly bear to dress," says a first-class passenger, and her male companion replies, "You should come round the troop decks with me when I am doing orderly officer's rounds. It really is hot down there." Or again a third-class passenger complains to the medical officer that the cabin is so hot that she cannot sleep, and the children's clothes are continually wet with perspiration.

Even the medical officer may think that he has to work in the hottest part of the ship, as he struggles with a large sick parade in the medical inspection room or deals with a difficult case in the troops hospital.

During the voyage of H.M.T. "Dorsetshire" to Bombay in February, 1933, an opportunity occurred to take a series of temperatures daily in a considerable number of localities in the vessel, to ascertain if there really were any grounds for the belief that the troop decks or any other accommodation was unusually hot. The average individual is concerned with his or her own type of accommodation, and the natural tendency is to consider one's own sufferings to be worse than those of others.

Unfortunately, for the purposes of such an investigation, the "trip" was not a hot one, and in fact during a greater part of the time temperatures were too low to be worth recording. During the period through the Red Sea and near Aden, however, fairly warm temperatures were experienced, or at least sufficiently warm to make the need for free movement of air felt and appreciated. Therefore during this period a regular series of temperature readings was obtained.

Dry bulb and wet bulb temperatures were obtained in each locality by means of an "Edney" swing hygrometer, which gives readings in a half to one minute. Two or three readings were always taken for accuracy.

The Edney swing hygrometer consists of a metal frame loosely pivoted on a handle. In the frame are two thermometers, one to give the dry bulb readings, and the other, the bulb of which is covered by a small silk bag, gives the wet bulb readings. The instrument is whirled round rapidly for a half to one minute and the temperatures read directly.

For the purpose of taking these readings a regular "round" was carried out daily between 3 and 6 p.m. The round took from one and a half to two and a half hours, varying with experience and interruptions. The time covers the period of the day which is felt to be hottest by most people.

The temperatures were taken at head level, except in one or two special localities, as in point 14, Table I, and in berth 149, Table VI, in which they were taken high up near the source of increased heat. The locality in each case was chosen as being a spot where normal activity of life was maintained, and the actual sites given in Table I are shown in the prints of the plan of the vessel. (See figs. 1 and 2.)

The actual sites where temperatures were taken *were selected to be out of the direct flow of air* from fans, blowers, wind-shoots or natural ventilation. The temperatures therefore represent the conditions in still parts of the compartment.

Relative humidity figures, from the temperature figures obtained, have also been added to Table I, since under the conditions of troopship accommodation relative humidity is of considerable importance for comfort and as an indication of possible danger.

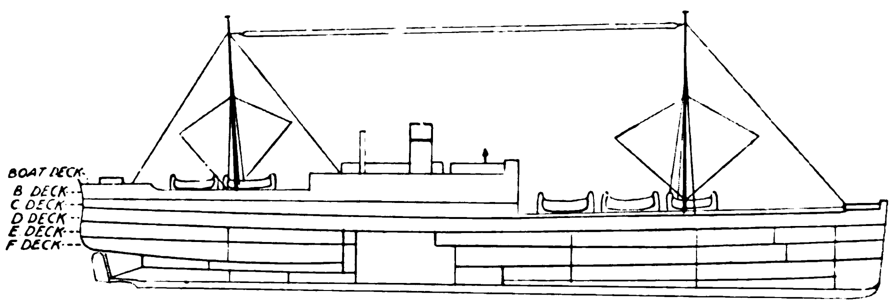

FIG. 1.—H.M.T. "Dorsetshire." General arrangement.

In addition, a series of katathermometer readings was also obtained in important localities to show how sensations of discomfort compared with actual figures and how much effect the forced ventilation was producing. An extensive range of katathermometer readings could not be obtained, owing to the time taken over each set of readings and that required for other duties; but the readings which have been obtained appear to give an appreciable amount of information for the purpose in mind.

In the case of the katathermometer tables the actual figures given are the mean of three to five readings.

The instrument used was a high-temperature katathermometer with a cooling range of 130° to 125° F., and a kata factor of 448. By means of a nomograph published by Messrs. J. J. Hicks, of Hatton Garden, E.C.. wind velocities and normal kata values can be readily computed.

The high-temperature katathermometer was described by T. C. Angus [1].

Briefly, it is an instrument similar to the original katathermometer except that the cooling range is raised 30°. The new instrument cools much more quickly and can be used at high air temperatures. This at the same time entails that the cooling power rate, expressed in millicalories per square centimetre per second, will with the reduction in time of cooling

be much higher, because its surface temperature is so much higher than that of the human skin.

The cooling power, as measured by the new high-temperature katathermometer, is therefore not used directly as a scale of comfort, but is only a link to determine air velocities. These air velocities so measured may be used to determine cooling powers according to the original scales'

The katathermometer figures are shown in Table II, and the computed wind velocities are given in Table III.

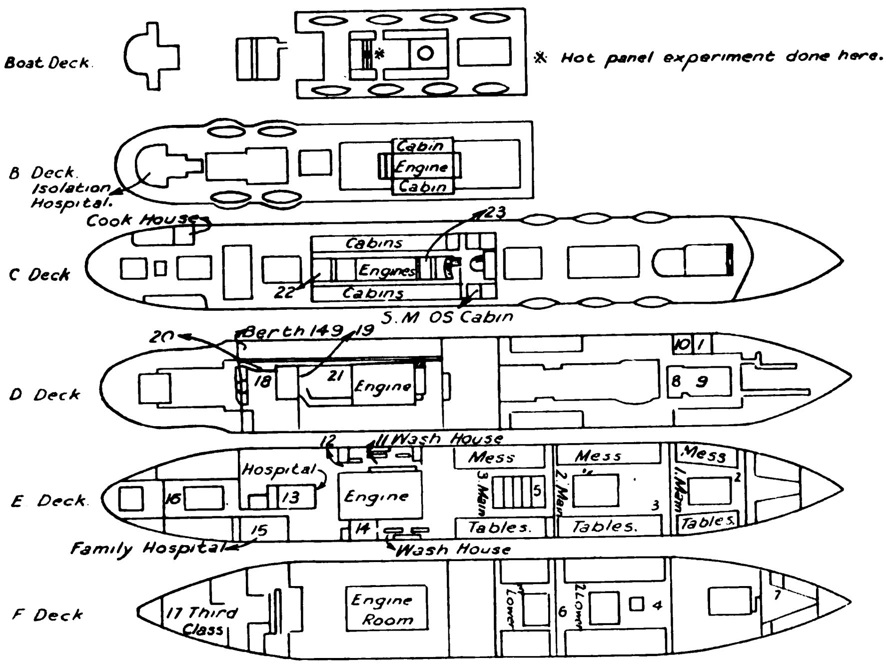

FIG. 2.—Plan of decks. H.M.T. "Dorsetshire." General arrangement.

In carrying out this series of readings, a regular round was observed for convenience. Commencing with the Senior Medical Officer's cabin, for an initial control, the round passed through the troop decks to the padded cell in the bows. The return journey was made through the hospital and third-class accommodation to the second-class and back to the first-class lavatories.

In the tables the various types of compartments have been grouped for convenient comparison.

As regards actual temperatures it will be seen that the complaint of the average first-class passenger, or even of the third-class passenger, cannot be justified.

The bakehouse and the troops' kitchen naturally show the highest temperatures. Though they can hardly be regarded as normal places of occupation, they show what conditions the baking and cooking personnel

TABLE I.—TROOPSHIP TEMPERATURES.

H.M.T. "DORSETSHIRE"—SOUTHAMPTON TO BOMBAY, FEBRUARY, 1933.

	Mediterranean						Suez Canal		Red Sea								Indian Ocean				
February	10th		11th		13th		15th		16th		17th		18th		19th		20th		21st		T. = Temperature H. = Humidity
	T.	H.	T.	H.	T.	H.	T.	H.	T.	H.	T.	H.	T.	H.	T.	H.	T.	H.	T.	H.	
	°	%	°	%	°	%	°	%	°	%	°	%	°	%	°	%	°	%	°	%	
1. S.M.O.'s cabin Starboard C.	69 64	75	63 58	72·5	69 63	70	67 58	55	70 61·5	59	75 68·5	71	81·5 74·5	70	86 80	76	84 78	75	80·5 73·5	70	Port hole open; door open
2. No. 1 main deck Central E.	68 62	65	63 57	67	72 65	67	71 61	53	75 66	60	80·5 72	68	81·5 76	77	82·5 76	73	80·5 74	72	82 75	71	Natural ventilation
3. No. 2 main deck Central E.	73 66	67	65 58	64	71 64	67	72 62	54	77·5 68	59	82 73·5	65	84 78	76	83 77·5	77	81 74·5	73	83 75	67	Blower
4. No. 2 lower deck Central F.	72 67	76	64 59	73	74 68	71	72 64	63	78 64·5	64	83 74	64	82·5 75	79	83·5 77·5	76	81 75·5	76	82·5 75	69	Blower
5. No. 3 main deck Central E.	70 63	66	66 60	69	73 67	71	70 62	62	77 67·5	60	81 73	66	82·5 74	76	82·5 75·5	72	81 75	74	82·5 75·5	69	2 blowers
6. No. 3 lower deck Central F.	68 63	75	66 61	71	72 66	71	71 63	62	71 63·5	60	79 71	66	81·5 75·5	75	83 77	75	81·5 75	73	81·5 75·5	74	Blower
7. Padded cell .. Port side F.	65 60	73·5	64 59	73	69 64	74	70 62	62	77·5 68	59	77·5 69	63	81·5 77	81	83·5 75	71	80 73·5	72	81·5 74·5	71	Blower and windshoot into guardroom
8. Troops' kitchen Central D.	80 67	48	71 68	85	78 69	62	71 63	62	89 73·5	47	84 71	51	91·5 87	83	85 74·5	63	83 74·5	66	90·5 82·5	70*	Through natural ventilation * Teas boiling
9. Bakehouse .. Central D.	86 69	39	71 62	57	84 71	51	71 60	57	95 74·5	37	97 82·5	52	98 83	52	96·5 82	52	94 80	53	98·5 83	56	Through natural ventilation
10. Dough room .. Port side D.	74 65	60	68 58	51	73 66	67	68 58	51	80·5 67·5	48	81 70·5	56	84 77	72	84 76	68	82 74	67	88 76	71	Through natural ventilation
11. Troops' washhouse .. Port side E.	76 70	73	70 64	71	73 67	71	74 67	68	73 69	80	81 72·5	65	86·5 81	78	85·5 78	71	84·5 77	70	85 78	72	Crowded at this time of day
12. M.T.R. passage Port side E.	76 65	58	69 61	61	74 69	77	73 62	59	75·5 65	52	82·5 71	55	86 78	69	87 77·5	64	85 77	69	86 78·5	70	Leads from washhouse to hospital
13. Troops' hospital Central E.	74 64	56	67 69	63	73 67	71	71 60	57	77 64	45	81 70·5	57	85 77	68	85·5 76·5	64	83·5 74	62	84 77	72	5 fans and 1 blower

14. Hospital washhouse Starboard E... ..	77 67 57	71 63 62	79 72 70	73 63 55	83·5 69 45	87 74 52	92 81·5 62	89·5 79 61	90·5 79 58	87 77·5 64	A group of steampipes overhead
15. Family hospital .. Starboard E... ..	70 62 62	68 61 65	73 64 59	73 62 59	78 65 47	82·5 72 61	84 77 72	85 76 64	81·5 74 69		3 fans
16. 3rd-class lounge .. Central E.	70 52 62	68 61 65	71 63 63	70 59 49	76 64 49	81 73 66	84 77 72	84 76 68	82 75 71		
17. 3rd class dining saloon Central F.	69 63 65	66 61 74	71 63 63	70 59 49	74 64 56	79 68·5 60	83 71·5 70	82·5 75 70	82 75 71		
18. 2nd-class dining saloon Starboard D... ..	73 63 55	65 58 63	70 65 75	70 60 53	77·5 65 53	81 70·5 61	84 77 72	86 78 69	84 75 64		Overhead fans
19. Alley way 1st-2nd class Port D.	80 67 48	64 59 73	77 65 50	72 60 63	75 63 49	82·5 72 58	83 76 71	87 77·5 64	83·5 75·5 68		Near engine-room casing
20. Alley way 2nd-class.. Lavatory port D ..	76 65 53	69 61 61	77 65 50	71 60 58	80·5 68·5 49	80 63·5 57	86·5 73·5 69	87 78 65	84·5 76 66		Near drying and ironing rooms
21. 1st class lavatory .. Central D.	79 73 73	75 70 73	75 65 65	75 67 64	77 68·5 52	81 71·5 61	83·5 78 50	85·5 78·5 72	85 75·5 66		Air duct and 1 fan
22. 1st-class lavatory .. Central C.	77 67 57	65 60 73	74 65 60	71 61 54	75 64 53	79 70 62	81·5 77·5 83	83·5 77 67	81·5 75·5 66		Open ports
23. No. 5 bath-room .. Central C.					79 66·5 49	82 71 64	88 82 77	86 78 69	86 77 65		1 fan
	Mediterranean			Suez Canal	Red Sea				Indian Ocean		
	Fine and warm. Light head wind off Africa	Cold breeze from Africa on starboard bow	Warm breeze from starboard quarter	Cold breeze from north port and east side	Cool north following wind starboard quarter	Cool light breeze port beam veering to head breeze	Strong head wind starboard bow. Lower ports closed	Feels cool, light breeze starboard beam	Light cool breeze starboard beam	Cool wind starboard beam, changed to warm following wind	Temperatures in degrees Fahrenheit

Temperatures (T) shown are Dry bulb.
Wet bulb.

Relative humidity (H) shows the percentage of moisture in relation to those temperatures.

Actual localities are shown on the diagrams of the plans of the vessel.
Localities have been grouped by classes for easy comparison.

TABLE II.—TROOPSHIP-TEMPERATURES. KATATHERMOMETER READINGS.

H.M.T. "Dorsetshire." Red Sea, 16th-19th February.

Locality	16th February							19th February							20th February							Remarks
	Cooling times in seconds		Actual temp. dry bulb	High kata values		*Normal kata* values		Cooling times		Actual temp. dry bulb	High kata values		*Normal kata* values		Cooling times		Actual temp. dry bulb	High kata values		*Normal kata* values		
	Dry	Wet		Dry	Wet	Dry	Wet	Dry	Wet		Dry	Wet	Dry	Wet	Dry	Wet		Dry	Wet	Dry	Wet	
1. Troops hospital near starboard alley	50	13	85°	9	35	2·6	12	46	12	85·5°	9·7	37	2·8	10·6	54	13	83	8·3	35	2·7	11·5	5 electric fans, 2 wind shoots, 1 large blower
2. 3rd-class lounge (lower) middle port side	57	17	84°	8	24·8	2·6	10·2	53	15	84°	8·3	29·7	2·6	9·7	55	15	81	8	29·7	2·8	10·5	Large blower 10 ft. away
3. S.M.O.'s cabin starboard C. deck	61	15	81·5°	7·2	29·7	2·6	10·2	34	14 cool	83° ing off	13·2	32·5	4·5	10·5	57	15	82·5	7·9	29·7	2·7	10	Port and door open
4. Sjts. mess, No. 1 main deck	55	14	82°	8·1	32·5	2·6	10·8															Near bows of ship
5. Cells middle ..	57	17	82°	7·8	26·8	2·6	9·5	54	15	82·5°	8·3	29·7	2·8	9·7								In bows of ship forward bulk head
6. No. 3 lower deck starboard	61	16	81·5°	7·2	28	2·6	9·5															All ports closed
7. No. 2 lower deck starboard								56	15	83°	8	29·7	2·7	9·7	48	15	81·5	9·2	29·7	3·2	10·2	All ports closed

Notes.—Cooling times (in seconds) are mean of 3—5 readings.

Actual temperatures are dry bulb Fahrenheit readings taken with the swing hygrometer.

In every locality a large electric blower was in full blast, except numbers 2 and 4 which had natural ventilation. All readings were taken at a point away from the perceptible influence of the blower.

For comfort and for physical work katathermometer readings should not be above—dry kata = 5; wet kata = 18.

It will be seen that in every case kata readings are below the standard of comfort and efficiency and these can only be obtained by forced ventilation.

This forced ventilation was perceptible in the majority of troops and families' accommodation, and with minimum clothing little discomfort was experienced except with physical work.

TABLE III.—TROOPSHIP TEMPERATURES.

Wind Velocities from Katathermometer Readings.

Locality	18th			19th			20th			Remarks.
	Kata		W. V.	Kata		W. V.	Kata		W. V.	
Troops' hospital, near starboard alley	2·6	12	44	2·8	10·6	65	2·7	11·5	20	5 electric fans, 2 wind shoots, 1 large blower
3rd-class lounge (lower) middle port side	2·6	8·2	20	2·6	9·7	25	2·8	10·5	12	Large blower, 10 ft. away
S.M.O.'s cabin, starboard C deck	2·6	10·2	5	4·5	10·5	16	2·7	10	12	Port and door open
Sgts. Mess, No. 1 main deck	2 6	10·8	15							Near bows of ship
Cells, middle ..	2·6	9·5	10	2·8	9·7	25				Against forward bulkhead large blower and wind shoot
No. 3 lower deck starboard	2·6	9·5	5							All ports closed, 1 large blower
No. 2 lower deck starboard	2·6			2·7	9·7	20	3·2	10·2	32	All ports closed, 1 large blower

Wind Velocities (W.V.) are in feet per minute.

may have to endure when air temperatures become really high. In the bakehouse the heat is a direct radiant heat with a low humidity and not nearly so uncomfortable as that in the cookhouse, in which, when teas are boiling, the humidity rises to 80 per cent. Both bakehouse and cookhouse have open walls on three sides and the cookhouse is practically open to all outside breezes.

In the troops' living areas temperatures and humidity are very even; the conditions in the lower troop decks, where port holes are closed, are practically constant at a comfortable level owing to the very efficient electric blowers. These blowers, although arranged to blow against a bulkhead, are so efficient that it is difficult to find a place without perceptible breeze in which to take katathermometer readings.

The troops' wash-houses tend to feel hot and sticky since they receive heat from the engine room, and the humidity is raised.

One of the most consistently uncomfortable places is the medical inspection room and the passage outside it. A crowd of men collect here in the mornings and also in the evenings for out-patient treatment. A special blower fixed in the hospital blows air into this area (temperatures were taken with this blower fully on), but the heat from the engine room affects it. In addition, in the medical inspection room, there is a steam heater for dressings, which adds heat and humidity to the room.

The third-class accommodation, although shut in, is relatively cool and fresh, thanks to numerous shoots and efficient blowers. The occupants of some of the cabins adjacent to the food preparation room and the clothes drying room, complained of excessive heat, but high temperatures were not obtained, as the effects of heat and steam from these were felt principally in the mornings, a time when it was impossible to take regular readings in such localities. Some of the second-class accommodation was distinctly hot, *vide* point 20, and this was enhanced where exposed steam pipes passed under the ceilings of the cabin, e.g., berth 149 (Table VI).

The first-class lavatory, D deck, always felt hot and sticky, being heated from the engine, but temperatures were not unusual.

Complaints were received that No. 5 bathroom, first-class, C deck, was exceptionally hot. This has several steam pipes in it giving radiant heat, and the humidity naturally varied with the amount of hot water in use. The heat did not appear excessive.

Katathermometer Readings.

From Table II it would appear that in no single instance are the criteria of 5 for dry kata or 18 for wet kata obtained. The readings were obtained in secluded corners deliberately chosen to be out of the direct influence of fans, blowers or wind-shoots, and indicating the conditions present without such adventitious aids.

In actual fact, one found that, in the lightest of clothing, one was sweating freely in such places, and Table III also shows that there were definite air currents available to assist evaporation. The need for a thorough forced ventilation is thus shown, and the fact that work could be carried on in comparative comfort indicates how efficiently that ventilation is carried out.

The conclusions to be drawn from these sets of figures appear to be that with the present system of ventilation, natural and artificial, temperatures and humidity are maintained at a very reasonable figure in all localities. The voyage was a cool one, and therefore temperatures did not approach danger zones for heat stroke, and it would appear that, so long as the ventilation is fully maintained, any great danger would be exceptional.

Localities where temperatures are relatively high are where heat from the engines, steam heaters, steam pipes or cooking appliances directly affect the area.

It is in these localities that improvements may be obtained by methods of insulation to be described below, and which are shown in Tables IV to VI.

Insulation by Aluminium Sheeting.

Dr. G. P. Crowden, working at the London School of Hygiene and Tropical Medicine and at Moascar (Ismailia on the Suez Canal), found that aluminium foil, mounted on a backing of material such as paper, proves a

most effective insulator, provided polished aluminum is used. This was the case both for short wave (high temperature) radiation and long wave (low temperature, 100° C. and under radiation).

The polished aluminium used in the experiments at the Army School of Hygiene was the proprietary type known as Alfol. This is used in the form of several layers of aluminium foil, slightly crumpled to give air spaces, and made up in panels protected within wire netting. The width of this foil is unsatisfactory and the method requires bulky and cumbersome panels.

Through the kindness of Dr. Crowden, who had managed to interest several firms in this method, samples of fine aluminium foil mounted on various materials have been obtained, but only the type mounted on thick paper was obtained in sufficient quantity for experiment. This was obtained from Messrs. J. J. Makin, the paper makers of Rochdale, and consists of a moderately thick paper backing with a layer of aluminium foil fixed with an adhesive paste on each side. It was obtained in rolls 26 inches wide at an approximate cost of 2½d. per square foot. This price is, however, a retail price of a specially made sample lot. If the material is produced on a large scale there would probably be a considerable reduction in price.

The material is about the same thickness and has the same stiffness as light-weight cardboard. For brevity and convenience it will be referred to as aluminium sheeting. The supply was received just in time, after embarkation, and during the hotter period of the voyage the three following demonstrations were carried out :—

A. Insulation of a hot wall, such as can be found all round engine-room casings, and which heats up adjacent cabins and alley ways.

A hot steel wall at the top of the engine-room hatch way was selected with the assistance of Mr. H. Robinson, the Chief Engineer, and Mr. E. Dalgleish, his Second Engineer.

The temperature of this wall is often too hot for the hand to be kept on it for long, as it is heated by the uptake from the galley flue.

Two test panels were arranged by the kindness of these officers as shown in the diagram of fig. 3.

It will be seen that by this means two similar panels were obtained with double air spaces under the outer brown paper panel, the whole being supported by horizontal wooden battens. Control thermometers, C and D, were placed on the upper wooden batten of each panel, equidistant from the hot steel wall, to record if there was any material difference between the two areas of wall. Two recording thermometers, A and B, were inserted through a small slit in the outer brown paper panel to record the temperatures in the outer air space of each panel, spaces Y and Z. These four thermometers were Centigrade instruments reading by 0·2° from 0° to 50° C., but for simplicity temperatures have been converted to Fahrenheit. The temperature in spaces X and W was too high for these

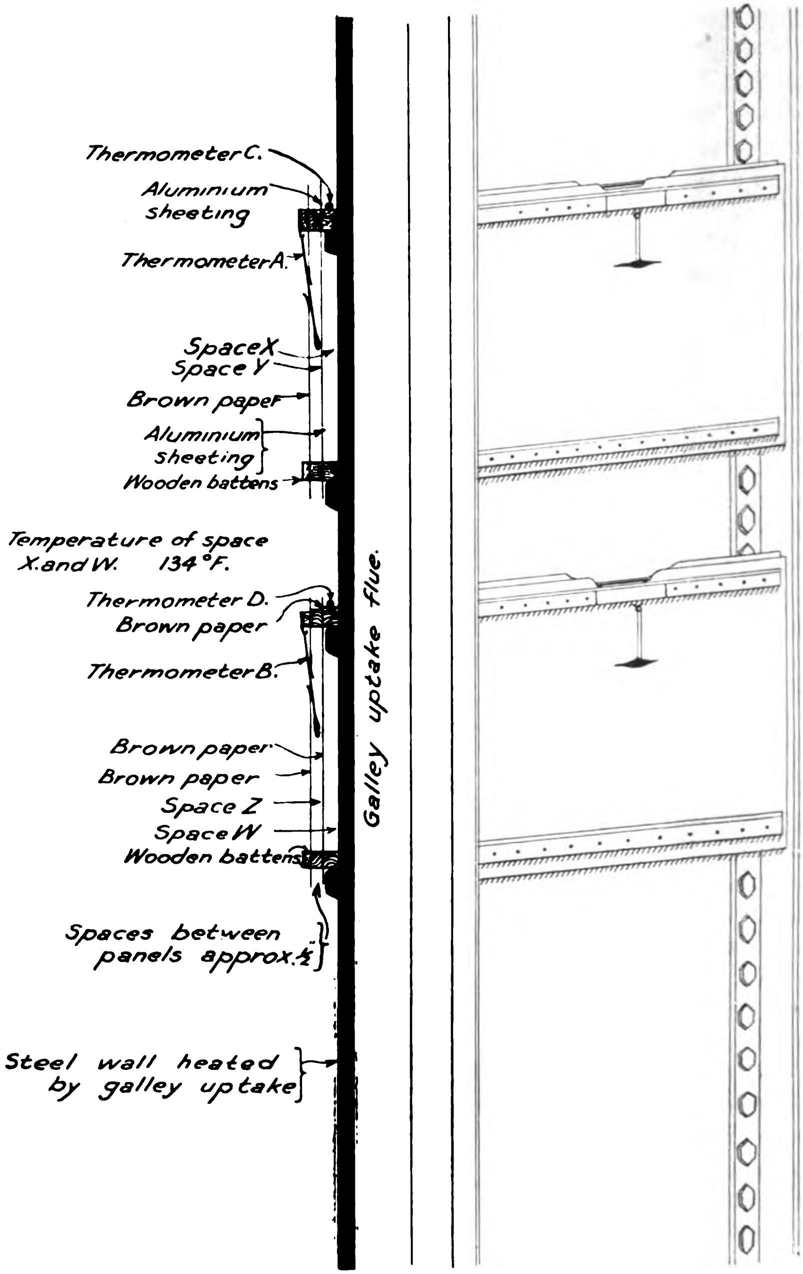

FIG. 3.—Hot Panel Experiment. Heat insulation by Aluminium Sheeting. H.M.T. "Dorsetshire," February, 1933. Difference between space Y and space X = 38° F. Space Z and space W = 26° F. Average difference between Thermometer A and Thermometer B = 9·71° F. (30 readings) see Table IV.

TABLE IV.—HEAT INSULATION BY ALUMINIUM SHEETING—HOT PANEL EXPERIMENT.

	20th Feb.			
Thermometer A ..	98·6	98·2	96·4	93·2
Thermometer B ..	107·6	108·0	107·2	104·0
Thermometer C ..				
Thermometer D ..				
Time of day ..	1500	1600	1730	1830
Difference between A and B	9·0	9·8	10·8	10·8

	21st Feb.							
Thermometer A ..	98·6	96·1	96·8	96·8	95·9	95·4	95·4	91·4
Thermometer B ..	108·5	108·5	109·4	110·3	107·6	104·0	104·9	100·0
Thermometer C ..			109·4	107·6	105·8	101·8	102·6	99·5
Thermometer D ..			105·8	106·7	104·0	101·5	100·4	99·5
Time of day ..	0745	1200	1230	1300	1330	1440	1600	2000
Difference between A and B	9·9	12·4	12·6	13·5	11·7	8·6	9·5	8·6
	Sun reaching corner of panel A. Control C and D placed on wooden frame above A and B.							Cool wind blowing down.

	22nd Feb.			
Thermometer A ..	91·8	92·8	98·6	91·4
Thermometer B ..	101·1	103·1	108·7	101·3
Thermometer C ..	101·5	102·9	107·3	101·3
Thermometer D ..	100·4	102·9	105·8	100·4
Time of day ..	0730	1115	1300	1900
Difference between A and B	9·3	10·3	10·1	9·9
				Following breeze. No cool wind blowing down as night came on.

	23rd Feb.						
Thermometer A ..	98·2	105·8	106·7	110·1	110·3	111·2	106·5
Thermometer B ..	108·0	119·8	117·5	118·8	117·7	119·5	112·1
Thermometer C ..	111·2	115·5	117·5	118·8	118·4	120·2	117·3
Thermometer D ..	105·8	114·8	114·8	117·5	118·4	120·6	115·5
Time of day ..	0800	1045	1130	1300	1400	1645	1800
Difference between A and B	9·8	14·0	10·8	8·7	7·4	8·3	5·6
							Cool evening breeze blowing down on to the panel B

	24th Feb.							Degrees Fahrenheit
Thermometer A ..	101·1	107·2	108·7	108·3	104·9	103·3	104·7	
Thermometer B ..	109·9	117·0	116·2	114·8	113·0	113·4	115·2	
Thermometer C ..	109·4	116·6	116·2	114·8	112·1	114·4	114·8	
Thermometer D ..	108·5	117·0	116·2	114·8	112·1	113·4	114·8	
Time of day ..	0730	0830	1245	1400	1530	1730	1830	
Difference between A and B	8·8	9·8	7·5	6·5	8·1	10·1	9·1	Average of 30 readings: 9·71° F.
		Sun would be on panels but hidden by light cloud.						Temperature between aluminium sheeting and hot panel, 134°F. *Difference between—* *Space Y and space X = 38° F.* *Space Z and space W = 26° F.*

thermometers, being in the neighbourhood of 130° F., and was not recorded regularly.

Space Y is protected from the heat radiating from the steel wall by a single layer of aluminium sheeting. Space Z is protected by a layer of brown paper of similar thickness. In each case there is an inner air space of half an inch for insulation.

Therefore, provided the heat from the steel wall is the same behind both panels, if there is any difference in the temperatures in spaces Y and Z, as shown by thermometers A and B, then it is probable that the difference is due to the different material which is interposed, viz., the aluminium sheeting. The tabulated results are shown in Table IV.

It will be observed that control thermometer D was often 1° to 2° cooler than C. This appeared to be due to the fact that the lower panel was close to the gangway grating and a strong down draught of cool wind was distinctly perceptible blowing down the gap between the grating and the wall. Actually this difference of temperature enhances the values of the readings from thermometers A and B.

TABLE V.—INSULATION BY ALUMINIUM SHEETING—STEAM WATER HEATER. ISOLATION HOSPITAL.—(See fig. 4.)

			Time	Air temp. Dry bulb	Thermometer A	Thermometer B	Remarks showing insulation
H.M.T. "Dorsetshire."	February, 1933	19th		° F.			
			1300	84	89·2	86·0	Cold water into heater
			1430	85	94·6	90·3	Heater, not covered
			1600	85	92·3	88·7	,, covered brown paper
			1730	85	90·5	86·9	,, covered aluminium
		20th	1215	89	91·4	88·7	,, ,, ,,
			1300	87	99·3	94·1	,, not covered
			1340	87	95·0	91·8	,, covered brown paper
			1450	87	95·0	91·8	,, ,, ,, ,,
		21st	0800	84	90·0	87·8	,, covered aluminium
			0830	84	94·1	91·8	,, not covered

Note.—The thermometer bulbs are not actually touching the wall, and are therefore really taking air temperature plus amount of radiant heat on to thermometer bulb. Bulbs were not blackened but bright, and therefore would absorb only small percentage of radiant heat from heater.

Thermometer B is somewhat affected by bathroom hot-water pipe. Covering consisted in completely encasing whole heater with the material as shown by dotted lines. Insulation of 4 degrees radiant heat on to thermometer bulbs.

It will also be observed that the temperatures vary considerably at different times of the day. This was due apparently to the difference when cooking was or was not in progress.

There was a marked and fairly constant difference between the readings of A and B, with a maximum of 14 and a minimum of 5·6 and an average difference of 9·7° F. for thirty readings.

This single layer of aluminium sheeting appears, therefore, to make a

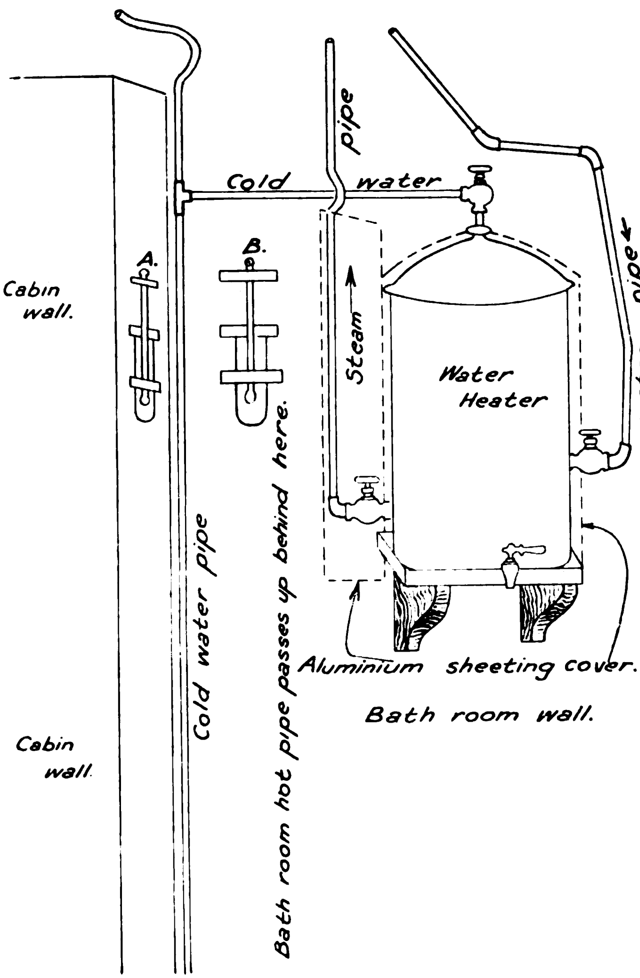

FIG. 4.—Insulation by Aluminium Sheeting, Steam Heater in Isolation Hospital. H.M.T. "Dorsetshire," February, 1933.

difference of 10° F. in the amount of heat which is being radiated off the steel wall to the space of the engine-room gangway.

This method should surely be applicable to the lessening of the heating effects of engine room casings and other hot bulkheads on adjacent cabins and alleyways.

B. Insulation of Hot Water and Other Steam-heated Apparatus.—In the central passage of the Isolation Hospital a small copper water heater is placed on a bracket near a corner. This is heated by a steam pipe and coil.

If the heater is in constant use the whole passage is heated to an uncomfortable degree, making the whole isolation accommodation remarkably hot.

A similar heater is situated in the Medical Inspection room, and produces the extremely uncomfortable results already noted.

Opportunity was taken on the occurrence of an infectious case, which brought the isolation hospital into use, to carry out a trial of the effects of insulation by aluminium sheeting as shown in the diagram (fig. 4).

Two thermometers, A and B, were fixed against the wall with adhesive tape, one alongside the steam heater and about one foot distant, the other opposite the heater on the protruding cabin wall, and about two feet distant. The bulb of each thermometer was protected from the steel walls by being slightly raised by the interposed pieces of aluminium sheeting and brown paper.

It should be noted that these thermometers had bright shining bulbs and would be affected by radiant heat from the heater to a minimum extent because the bulbs themselves would reflect away the heat rays. This certainly accounts for the small differences observed. Unfortunately the black matt paint used previously for absorption of heat rays was not accessible in my baggage.

As a control air temperatures were also taken two feet from the heater by means of the swing hygrometer.

Two coverings were made to enclose the heater and the steam pipe, leaving an air space of from half to one inch. One was of brown paper, the other of aluminium sheeting.

It will be observed that when the heater was not covered, thermometer A was heated 10° by radiation; with the brown paper covering over the heater A was heated 8°; but with aluminium sheeting A was only heated 2½° to 6°.

A point worth noting was that the steam and hot water affect the fixative used in the aluminium sheeting, and the aluminium separates off from the supporting paper, though it still retains its function provided it does not get torn or pulled away.

Some form of water-insoluble fixative is required for places where steam or damp is likely to be encountered, and a non-absorbent base in lieu of the paper.

The difference in temperatures shown in this test is less apparent than could really be felt owing to other factors which affected the thermometers, such as heating of the walls by the bathroom pipes.

This aluminium covering was subsequently placed over the heater in the Medical Inspection room and the staff were unanimous in proclaiming

a marked lessening of the radiation from that heater, and a marked improvement in the comfort of that room. Unfortunately, time did not permit any further records of temperatures in this place.

Surely this method could be brought into use to prevent the heating up of closed compartments by such hot water or other heating appliances.

C. The Insulation of Steam Pipes.—In this case complaints were received that the temperature on berth No. 149 was "unbearable."

On investigation it was found that this berth was an upper one in a four-berth cabin of the usual L shape. Immediately above the berth, and in a position at which one would naturally grasp in getting into that berth, was a double steam pipe, extending from the side wall and up through the cabin roof, about three feet of pipe being exposed. The pipe was of the usual type with a thin canvas lagging closely applied, and was too hot to hold in the hand.

The heat from this pipe varied in accordance with the times at which the boiler outside the second-class cookhouse, which is immediately over this cabin, was being heated.

Temperatures were taken about one foot above the berth at three periods in the day, and control temperatures were taken immediately afterwards in the family hospital and S.M.O.'s cabin. The results are given in Table VI.

TABLE VI.—INSULATION OF STEAM PIPES.

2ND CLASS CABIN, BERTH NO. 149.

Occupant of Berth 149 complained of heat from steam pipes immediately over bunk.
Temperatures for one day were taken as control.
The stem pipes (about 2½ ft.) were encased loosely with aluminium sheeting tied with string as a temporary measure. The sheeting was of necessity touching the pipe in several places.

H.M.T. "Dorsetshire," February, 1933.

	1100 hrs.		1400 hrs.		1700 hrs.		Aluminium insulation applied over berth No. 149	0900 hrs.		1230 hrs.		1700 hrs.		1100 hrs.	
	Dry	Wet	*Dry*	Wet	*Dry*	Wet		*Dry*	Wet	*Dry*	Wet	*Dry*	Wet	*Dry*	Wet
S.M.O.'s cabin	78	72	78·5	71·5	79·5	73·5		79·6	73·4	79	73	80	75	78	71
Family hosptl.	82	73	84	76	83	76		82	75	81·5	75	83	76	81	72
Berth 149 ..	92·5	79	91	79·5	95	82		80·5	71·5	85·6	77	83	78	80	71

The readings in Fahrenheit appear to show a reduction of 6–8° F. at least produced by insulating this pipe.
All the occupants were unanimous in stating that the cabin had been markedly cooled.

Note.—A cookhouse is situated over this cabin and when cooking is going on the whole cabin heats up considerably. Cooking hours chiefly 1100–1200 hrs., 1600–1700 hrs., 0600–0700 hrs.

It will be seen that there was justification for the complaint, the berth being 10° to 15° hotter than other normal compartments. The steam pipes were then loosely enclosed in some pieces of aluminium sheeting, which were fitted round and tied on, in quite a makeshift manner, with string.

The difference in temperature of the berth was at once perceptible even while carrying out the work, and the occupant of the berth was quite emphatic and thankful for the improvement achieved. The temperature recorded after the insulation of the pipe bear out the improvement, even though the heating of the steel roof of the cabin, from the cookhouse above it, was not dealt with in any way. At temperatures of this range, or even higher, a lowering of 10° or even 7° makes a very considerable difference in comfort.

Surely this method could be brought into use in many localities in the vessel for reduction of temperatures and the conservation of heat in its right place.

General Conclusions and Recommendations.

Aluminium sheeting or aluminium foil mounted on both sides of a simple paper backing appears to offer an extremely simple and effective method of reducing the heat radiating into certain compartments, and a method of conserving the heat where it is wanted.

It is suggested that a panelling of the material should be carried out all over the steel walls of the engine room and such hot structures as the funnel casing and silencers. It would appear from the first experiment that cabins which are excessively heated by a hot wall, i.e., the Chief Engineer's cabin and many others, could be cooled 10° by a simple panelling of this type. The aluminium sheeting could be protected by a suitable outer panelling. Alternatively, the insulation could be applied round the whole of the funnel casing, thus avoiding the heating of the cabin walls.

Similarly all steam pipes could be encased in a loose sheath of this material where they are exposed in cabins, bathrooms, etc. This would protect the compartment from unnecessary heat, maintain the heat of the pipes and prevent unnecessary condensation.

Similarly, hot water and cooking appliances could be insulated by this material with improvement in comfort and conservation of heat. There are certain objections to the present material which require remedy, and the question will be taken up with the manufacturers. For example, aluminium sheeting with a paper base is inflammable. If asbestos sheeting were substituted for the paper, a fireproof insulation would be available.

Another serious defect with the present material is the effect of steam or damp on the fixative. A waterproof fixative is imperative. An essential point which may form a drawback in some cases is the need for a small space or gap between the heated surface and the aluminium sheeting. This gap can probably be reduced to a quarter or even an eighth of an inch, but the need for it remains.

It is hoped that this small series of records and tests may be of value in improving the condition on His Majesty's trooping vessels.

My grateful thanks are due to Mr. Robinson and Mr. Dalgleish, the Chief and Second Engineers, and to Captain C. Fountain, the Captain of H.M.T. "Dorsetshire," for the help and great interest which they took in these experiments. Also to Lieutenant Hope Dunbar for photographs of the plans of the vessel and, finally, to Mr. L. G. Hemans, of the Chemical Research Defence establishment, who has kindly checked the details of the katathermometer work.

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TROPICAL TYPHUS AND THE WEIL-FELIX REACTION.[1]

By Major R. F. Bridges,

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The question of tropical typhus is one which has come into increasing prominence during the last few years as a result of the recognition of the fact that this disease in its different forms occurs in parts of the world where its existence had not previously been suspected. In India the disease has been known for some years, more particularly as a result of the work of Megaw on the variety of tropical typhus which occurs in the Kumaon hills. Cases from other parts of India have recently been reported in the pages of the Journal of the Royal Army Medical Corps, from Bangalore by Biggam, and from Delhi by Christian and Hepple. Numerous other cases, occurring in various parts of India, have been recorded in our military statistics for the year 1932.

Both in connection with typhus exanthematicus and with numerous forms of tropical typhus the Weil-Felix reaction, carried out with the X strains of *Bacillus proteus*, has come to be regarded as a specific diagnostic test for these diseases. It is necessary, therefore, that all laboratory workers in India should be well acquainted with the details of the test and be prepared to carry out this reaction on any suspected case.

Most workers are familiar with organisms of the Proteus group, the characteristic feature of which is their power of spreading or swarming over the surface of solid media, to form a film-like growth in which no isolated colonies can be detected. Such cultures, known as "*hauch*" or H form of the organism, contain both the O (somatic) and H (flagellar) antigens. As a result of the presence of flagella the bacilli in these cultures are highly motile. But organisms of the Proteus group can also occur in a form which, either permanently or, as is more usual, temporarily, has lost the power of swarming. When cultures of this kind are spread on a plate individual colonies are obtained which in appearance differ little from those of bacilli of the dysentery or Salmonella groups. In such cultures it will be found that the organisms are non-motile and, being devoid of flagella, contain only the O (somatic) antigen. They are known as the O or "*ohne hauch*" form of the organism.

In culture it is found that there is a general tendency for O cultures to acquire flagella and thus to turn into H cultures. But in old laboratory cultures the reverse process is sometimes seen. By various laboratory procedures it is possible in most cases to obtain at will O cultures from H cultures, and H cultures from O cultures. The technique is simple and will suggest itself to experienced workers.

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[1] A paper circulated to the military laboratories in India.

In connexion with the Weil-Felix reaction three strains of Proteus have come to be recognized as of importance and significance. These are known as X2, X19, and XK, and it is advisable to give a short account of the history of these strains in order that the principles underlying the test may be appreciated.

The strain X2 was the first to be isolated. It was obtained by Dr. Felix in 1915, from the blood of a patient suffering from typhus fever. It was found that this organism was agglutinated by the serum of typhus patients, although not in very high titre. Some time later the strain X19 was isolated, also from blood, and it was at once seen that this strain was of far greater significance in connexion with typhus fever than was the previously isolated strain X2. Titres reaching 1 in 5,000 or 10,000 were obtained with X19, while those with X2 had been in the region of 1 in 500 or less.

Since these two strains were isolated they have been subjected to much investigation and it has been found that, so far as their H antigens are concerned, they are practically identical. The difference between them in cross-absorption experiments amounts to about 0·2 per cent of their antigenic content, an insignificant difference which is not observable in simple cross-agglutination tests. It was only when the study was extended to their O composition that the essential difference between the two strains came to light. It was found that, apart from some traces of a common factor, the two O antigens were distinct in their composition. Hence no cross-agglutination or absorption, except in very minor degree, could be obtained between the two strains. The question of nomenclature, therefore, at once arises, for it is evidently incorrect to describe these bacilli as different "strains" of the same organism. They are obviously different "types" of the *B. proteus* X—as different from one another as are V and W of the Flexner group, or the Newport and Reading types of the Salmonella group. But the use of the word "strains" is of such frequent occurrence in the literature of the subject that it must be allowed to pass, although its inherent inconsistency should be noted. When mentioning the different forms in which these organisms can appear it is usual to refer to them as OX2 and HX2, OX19 and HX19.

We come now to the third strain which has taken a prominent place in the literature during the last few years. It is called the Kingsbury strain of *B. proteus* X or, more simply, XK. Its history affords one of the most remarkable examples of transmutation of type known to bacteriology. The strain was originally obtained from the Lister Institute in 1921 as an ordinary culture of X19, and as such was taken by Dr. Kingsbury to Kuala Lumpur in the Federated Malay States. Here it was maintained in culture for some years. Now, tropical typhus is a common disease in that part of the world, and it was found that many of the cases gave positive results when their serums were tested with a strain of X19 which had been obtained from Warsaw in 1925 by Dr. Fletcher, the Director of the

Institute at Kuala Lumpur. Other cases, however, were negative. It occurred to Fletcher to test the serum of these cases against the Kingsbury strain, which in the meantime had been lying in the laboratory unnoticed. To his surprise he found that all those cases which gave negative results with the Warsaw strain reacted to highly significant titres with the Kingsbury strain and, vice versa, those that were positive with Warsaw were negative with Kingsbury. Thus it was possible to divide the typhus-like fevers of Kuala Lumpur into two very distinct groups, a distinction which was subsequently confirmed by facts which came to light in regard to the areas of distribution of the two diseases. It was found that the cases which reacted with the Kingsbury strain were mainly confined to people living in the country districts, while those which reacted with the Warsaw strain chiefly occurred among the urban population. In accordance with these distinctions the two diseases are now known as "scrub" typhus and "shop" typhus.

These rather striking facts naturally led to a careful examination of the nature of the two strains concerned. It was found that, while Warsaw was a typical example of X19 Kingsbury, originally regarded as an X19, had in the course of years assumed entirely different characters. The majority of Proteus strains, including X2 and X19, generate abundant indol in peptone water; the Kingsbury strain is negative in this respect. Serologically, the H antigen of the Kingsbury strain is for the most part identical with those of X2 and X19, although the difference is greater than that which has already been noted as existing between these two organisms. The difference in the case of the Kingsbury strain reaches about twenty per cent of antigenic content, an amount which is sufficient to show fairly wide differences in readings in cross-agglutination tests. As regards the somatic portion of the organism, it is important to note that no community of O antigen exists between XK and either X2 or X19.

As regards the strains which have been used in India, the Warsaw and Kingsbury strains were obtained direct from Dr. Fletcher in 1927 by the Officer-in-charge, Enteric Fever Command Depot Laboratory, Naini Tal, and on transfer of the laboratory to Kasauli in 1928 they have since been maintained in the enteric laboratory. In the matter of nomenclature, Warsaw, as we have seen, is (or was!) a genuine X19, and may therefore be referred to as *B. proteus* X19 strain Warsaw. Kingsbury, on the other hand, is a separate entity and should be designated *B. proteus* X Kingsbury, or more simply, XK. Its H and O variants may be referred to as HXK and OXK.

One other strain must be mentioned, since it has appeared in print in recent papers which have been published in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS—the so-called Multesar strain. This strain, which was regarded as an ordinary X19, was obtained in 1926 by the Officer-in-charge, Enteric Fever Command Depot Laboratory, Naini Tal, from the Director of the Veterinary Institute at Muktesar in the Kumaon hills. With other

Proteus X strains it has since been maintained in the enteric laboratory, Kasauli. During the course of years it has changed one letter of its name, from Muktesar to Multesar, but whether this change has been accompanied by any form of reorganization in its antigenic equipment is not yet known; the matter is under investigation at Kasauli. As the name Multesar has appeared in the pages of the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, it is perhaps as well that it should retain this modified form.

As regards future work on tropical typhus in India it would seem that the use of strains Warsaw and Multesar in the performance of the Weil-Felix test might well be discontinued, since both of these, so far as is known at present, are ordinary strains of *B. proteus* X19. It would be better that tests should be confined to one strain of each of the three classical types, X2, X19 and XK. Fresh cultures of these have recently been acquired from the Lister Institute.

It must be understood that in the Weil-Felix test agglutination of the H antigen of the Proteus X strains has no significance of any kind, since this reaction may be positive in persons suffering from other diseases and even in healthy individuals. It is only the agglutination of the O antigen which can be regarded as diagnostic of typhus or tropical typhus fevers. It is essential, therefore, that suspensions for the use in the Weil-Felix test should be capable of reacting to the O agglutinin, and that this potentiality should not be overshadowed or inhibited, either of which may well be the case, by the presence in the suspension of other antigenic elements which may or may not be agglutinated. Now it has been shown that there is a continual tendency for O cultures to become H cultures, and moreover the presence of H antigen in a culture cannot be definitely excluded by the naked eye appearances of the growth. Still less can it be excluded by the presence of a label on the tube. Further, variant antigens in the form of roughness are persistently liable to arise. It will thus be understood that, while preparation of suspensions for the Weil-Felix test offers no peculiar technical difficulties, yet it demands the exercise of a considerable degree of care in the selection of growths and in the method of preparation. For these reasons and in the interests of uniformity it is desirable that all laboratories in India should obtain their requirements of agglutinable suspensions from the Enteric Laboratory, Kasauli.

A few remarks must now be made on what is perhaps the most enlightening aspect of the Weil-Felix test. Few observers are now in a position to doubt, or would attempt to refute, the complete specificity of the test. And yet the exact position of the Proteus group in relation to the virus of typhus and the typhus-like fevers remains an unexplained problem. Felix has throughout maintained that the X strains bear a direct relationship to the virus of the disease, and it would seem that many observers, previously sceptical, are now inclined to accept his views. No one would suggest that the Proteus organisms, as such, are the cause of typhus fever; but a study of the literature and more particularly the accounts of

certain recent experimental work lead inevitably to the conclusion that these organisms are in some sense a stage in the life-cycle of typhus virus.

If we accept this view of the Proteus X strains and of their significance in connection with the Weil-Felix test, then we are drawn to certain further considerations. We have seen that the reaction with *B. proteus* type X19 constitutes a specific test for typhus exanthematicus and for the fever known as shop-typhus of the Federated Malay States. The same is true for tabardillo or Mexican typhus, for Brill's disease of the U.S.A., and for endemic typhus of Australia. On the other hand the reaction with *B. proteus* type XK constitutes a specific test for scrub-typhus of the Federated Malay States. In all the above diseases titres reaching 1 in 5,000 or 1 in 10,000 have been obtained with the appropriate type of *B. proteus* X. In other forms of tropical typhus such clear-cut results as the above have not up to the present been obtained. Thus, the typhus-like fever known as tsutsugamushi in Japan and Sumatra gives weak positive results with XK and negative results with X19. The *fièvre exanthématique* of Marseilles gives weak positive results with X19 and negative results with XK. In the case of Rocky Mountain spotted fever serum reactions are only partially positive with both types. The explanation of these partially positive or negative results would seem to be that the types of *Proteus* X at present available are only distantly related to the viruses of these diseases. On the other hand, the strongly positive results which are obtained with X19 and XK in certain other forms of typhus are an indication that these organisms are more directly related to the viruses concerned. An exact parallel is found in fevers caused by organisms of the Salmonella group. A patient suffering from paratyphoid C fever will give negative or weak positive results with *B. paratyphosus* B. It is only when we have isolated the *B. paratyphosus* C itself and make use of this organism in the test that we can expect to obtain results which are with certainty indicative of infection.

In the case of tropical typhus occurring in India, therefore, we cannot necessarily expect to obtain the very high titres which are found in typhus exanthematicus and some other typhus-like fevers. Titres of 1 in 200 or 1 in 100 are significant of infection, and even a reaction at 1 in 50 should not be disregarded, more especially if there is any rise in titre during the course of the fever. At the same time laboratory workers throughout India should be on the look-out for Proteus strains and should endeavour to isolate them from blood and urine in suspected cases of tropical typhus fever. Any strains of this kind which may be isolated should be used in agglutination tests with the patient's serum and should be subjected to examination as to whether they are identical with or related to one or other of the classical types of *B. proteus* X. With a view to facilitating this work agglutinating serums against the three types of *B. proteus* X are now in course of preparation at Kasauli and will shortly be available for issue.

ON AND ABOUT KAMET—1913.

By Major C. H. H. HAROLD, O.B.E.,
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(*Continued from p.* 33.)

The weather being bitterly cold we now had trouble with the coolies, and after a lapse of years I cannot recollect whether we marched one or two intermediate stages, but we eventually established ourselves in camp on a grassy plateau. That night the coolies were late, and our staff, knowing Slingsby well, were depressed, unhandy in their work and came under constant reproof. I rather think that we were again delayed by coolie trouble and the recovery of loads, but Todd had originally sent a runner to Badrinath to keep in touch with the Rawal Sahib. That evening the wind had dropped and the weather was warmer. It was dusk, and as I was changing into my flannel bags, there arose shouts of coolies and barking of dogs. Calling to my bearer, I asked what was the matter, and he informed me that they were just bringing in the sahib, that he was very ill and could not walk as something had injured him. Dressing with all possible speed, I emerged and found that the combined camp staffs had literally fallen on Slingsby's loads and reduced them to ship-shape in no time and his tent was practically ready for occupation. I went along to Todd's tent and a worn, bearded Slingsby was handed over to me. Quickly he was put to bed and given a complete overhaul. I found that his recent experiences had taken much out of him and he was very fine drawn. His heart and lungs were sound, but there was slight dilatation of the heart with some accentuation of the pulmonary second sounds. His speech was indistinct and he was suffering from a right-sided hemiplegia, which was clearing up rapidly. He informed me that he had been insensible for a day or so, and the Rawal Sahib had got up the sub-assistant surgeon from Joshimath to see him. His first recollections were finding himself in bed in the Badrinath Rest House, unable to speak properly or to get out of bed. Half his body felt asleep and he noticed he had not the full use of his arm and leg. He was now much better, and hearing we were quite near he had asked to be brought along to us.

I then decided that the moving of Slingsby to varying levels might easily aggravate his condition, possibly result in an increase of his paralysis, and he would arrive in India a finished man. Finding we were in a good camp site at about 14,000 feet, I recommended staying there for at least a week, until we saw how Slingsby progressed. I then gave orders that Slingsby should remain in bed and abstain from smoking. In the meantime I wrote some prescriptions which I despatched by runner to Joshimath dispensary.

That evening the cook drawing a few additional articles from our stores, put up a "burra khana" in honour of the event, and we had our evening meal alongside a camp fire in front of Slingsby's tent. After dinner we found the odd cheroot and settled down to listen to his yarn.

Shortly after writing to Todd, the weather being perfect, he felt he could not delay longer and moved his base camp forward to a selected site. Commencing the ascent, he was extremely pleased with the good progress he made compared with his previous attempt. He, however, thought, and also the local coolies predicted, that a change of weather threatened, but he was hopeful that he could complete his task before storms really broke over the summit. He now had advanced his camp higher than before and assured his porters that they had every prospect of success. By this time both he and his orderlies were feeling the effects of mountain sickness, but managed to carry on with biscuit, beeftea and chocolate. They experienced considerable trouble in lighting the primus stove to melt the snow and boil the kettle to make cocoa and milk and tea. Later, owing to the feelings of nausea, they had the greatest difficulty in retaining fluids. During the night the weather broke, and gales, succeeded by a heavy snowfall were experienced. Next day, in spite of a continuous snow-storm, he managed to advance his camp, but all were completely done in and his orderlies stupid with cold.

Slingsby still considered that, given a fair period, he had a good chance of success. They continued their efforts on the following day and passed his previous record, attaining a height of 23,000 feet, but were forced to descend. Now his orderlies, in their attempts to fill and boil the kettle, were frost-bitten in turn, and became so apathetic and useless that all the odd duties devolved upon him. In the end, owing to an incautious exposure, under the stress of these conditions, he himself was also frost-bitten.

Some of his men now asked to be allowed to return to the base camp as they were unable to eat or sleep and were of little use. As the snow-storm and wind showed no signs of abating, Slingsby at length decided they could hold on no longer in the face of these terrible climatic conditions, and as the return journey would tax their powers to the utmost, it was necessary to abandon the camp with all his gear. This they did, and after a great struggle approaching their base camp, they met coolies who, on seeing their condition, brought juniper brushwood and kindled a small fire at which all attempted to warm themselves.

Slingsby, for some reason unknown and contrary to his own orders, took off his boots and warmed his frost-bitten feet. Shortly afterwards he tumbled over and knew no more. He was carried into camp and news was sent to the Rawal Sahib, who despatched a rescue party with a litter and brought him in to Badrinath.

Next day a still further improvement was noticeable in Slingsby's condition. He gave as his opinion that climatic conditions on Kamet would not improve for some time and that the "burra bursat" had broken. I then

intimated that, as Todd's knee had been giving trouble, all ideas of further attempts that year should be abandoned, unless something quite unprecedented arose, and that Slingsby's case was not one of a simple fainting fit following strain and fatigue or mountain sickness, but a definite stroke which might imperil his whole future. This was a sad blow to Todd who saw the fruits of a year's preparation disappearing before his eyes. He tried to hide his disappointment, but I imagine he still harboured a lurking hope of making an attempt later, but for the present, in view of Slingsby's condition, he was forced to relegate it to the background.

Todd and Slingsby. Slingsby with beard recovering from frost-bite.

The next few days passed pleasantly, and Slingsby improved so rapidly that it was possible to note changes in his condition from day to day. He could walk a little, his hand and leg gained power and his speech cleared. I suggested that in a few days he would be capable of moving back to India by pony, and one was obtained through the Rawal Sahib. As we were proceeding northwards we took over additional supplies from Slingsby and readjusted our loads. Our messing reverted to its usual good standard, sheep and goats were killed, and a small present of guavas was received from Joshimath with our mail. Wild rhubarb, which has a wide range of growth and is a universal standby of all shikaris, was also included in our menus and provided a welcome addition. Some years afterwards the recognition of a smaller variety on the hills of the salt desert of East Persia was a means of alleviating the sufferings of hundreds of cases of scurvy in an Indian Labour Corps working on the road which was being made from Dusdap to Askabad. On this occasion parties of levies with camels

managed to collect a sufficient quantity and so tided over the period, pending the arrival of unsplit dhal and other anti-scorbutic agents from India.

To continue, on these days we wandered about the mountain sides taking snapshots and admiring the hill flowers growing in sheltered nooks, and at night gathered round the camp fire, where Slingsby and Todd compared notes.

One afternoon we crossed a whole hillside entirely covered with strawberry plants set so close together, that each footstep showed up red from the crushed berries. The largest was as big as a thumb nail and the Gurkhas sat down and ate their fill. We collected enough to provide a tea of strawberries and condensed milk, and although lacking in flavour, the novelty was agreeably reminiscent of the home-grown article.

Badrinath.

The day of separation arrived and Slingsby left on his pony, promising to send up news of his progress on his way down towards the plains. It was a sad parting in a way, for it seemed but yesterday that we had set out full of hope and confidence to pit ourselves against this unconquered mountain, and this was the end of the venture as far as poor Slingsby was concerned. The inexorable hand of fate had intervened and barred his path to success by blizzards, snow-storms and mountain sickness and now he was being led back to India a crippled man, with his prospects as a soldier in the balance.

Still, time and time again, men of his mettle suffer reverses at the hands of these enemies of the mountaineer, only to return to the attack, recking danger and hardship as but the spice which adds a thrill to the undertaking.

After seeing Slingsby started on his return journey Todd and I moved off along a rather pleasant and grassy pass and then, with the sun blazing on us, zig-zagged down the mountain side to near Badrinath. It was a tiring march as we were wet with sweat and longed for the tempering breeze of our last camp. Arriving at the Rest House, we looked across at the Holy Temple with its golden roof, which, if my memory does not play me false, had been presented by a member of the Kashmir House. On arrival we sent salaams by our chapprassi to the Rawal Sahib, to whom we wished to acknowledge our indebtedness for the care of Slingsby, and his assistance in obtaining coolies for us. In due course we received an official invitation to the Temple and tidied ourselves up as much as possible to do honour to the occasion. After tiffin we left our bungalow preceded by a regular " fou fou " band, in which pipes and drums were the main implements, played by the raggedest collection of urchins and men imaginable. This was followed by two mace bearers, with silver-gilt maces, garbed in tolerable khaki coats and red sashes, but with nondescript ragged and dirty trousers. Then followed ourselves in sun-proof coats and, not to forget it,

wearing khaki ties and undamaged shorts. Lastly, our Gurkha henchmen in new black alpaca shorts, khaki shirts and the brightest of knitted scarves, in which greens and reds predominated, wound pagri-wise around their heads.

We met the Rawal Sahib and temple officials in durbar and partook of the holy salt flavoured with herbs and asafœtida, and I trust my face did not register the shock imparted to my palate by the unexpected taste. After an exchange of remarks on the weather, the state of the road, Todd gave details of our Service, stations and a summary of the object of our trip. Whilst this was proceeding, I was enabled to look about and noted that the Rawal Sahib was a Madrassi of some bulk, enveloped in a padded cotton coat of Indian manufacture. He complained bitterly of the cold and of his enforced isolation from the plains imposed by the long and rugged road. He had a cast or glide in one eye. After the usual interchange of small news items, an inquiry after Slingsby, and an expression of satisfaction at the opportunity of being of assistance, we proceeded to the Temple proper. Approaching the shrine, in which the image was but poorly illuminated by the sun's rays, reflected by a mirror, we tendered our offerings and sundry strips of gilded and silvered paper were burnt in front of it. I was unable to note any particular details of the idol, except that it was of carved black stone, and it did not appear that the authorities welcomed a particular inspection of it. We now passed to a geyser-heated pool in which the cripples are immersed and made an offering to the attendant here. I was informed that a fakir who sometimes sat in a really hot spring was not present that day. Near the pool were crutches and walking sticks which had been discarded by the cured. The suppliant is initially immersed in the waters of the geyser, and after being well hotted up, is carried down the steps to the Holy Alaknanda (Ganges) and placed in the grip of its icy glacier waters. It is quite obvious that a shock of such an intensity would stimulate the hardiest paralytic to almost convulsive attempts at movement. A repetition of this was occasionally carried out and in the case of true believers, such a line of treatment might reasonably prove successful, particularly in auto-suggestive cases, when all orthodox methods have failed.

We then returned to our Rest House, after thanking the officials for their courtesy and kindness, and received in return what I was told were the badges of accepted pilgrims, viz., a replica of the image in silver, another in copper and a small photograph of the same, all enclosed in a strip of bright yellow (holy coloured) silk.

That evening we had just finished our soup and meat courses when the notes of the "fou fou" band heralded something untoward, and the servants dashed in to say that the mace bearers had arrived with a feast.

Our appetites were well on the way to being appeased, but on this special occasion it was undoubtedly incumbent upon us to defer to the usages of hospitality. The table was cleared and highly ornate silver trays crowded

with silver bowls and platters of like design, were passed round. These trays and their contents were as much as a man could carry, and piled up on the platters were pilau, kabobs, mutton, chicken, curries, ginger, dried fruits, roast salted almonds, pistachio nuts, sweetmeats and dried coconut. After partaking of a little pilau and ginger and retaining a proportion of the fruit and nuts, the trays passed out to the care of our servants, who, I imagine, made good use of the opportunity. Next day I saw the havildar filling a biscuit tin with cooked rice for despatch to Nepal on the first suitable opportunity, as he was anxious that his relatives should also participate in the spiritual benefits of his pilgrimage. Whether cooked rice, even when treated with ghee and saffron, would survive such a passage of time and still prove edible, I do not know. At the conclusion of the feast the mace bearers were brought in by the orderlies and offerings for the use of the poor were made by us, but judging by the prevalence of rags and other emblems of poverty our mites would avail but little.

Mana and the Glaciers around Kamet.

We now moved camp above Mana to the scene of Slingsby's attempt. A bitter wind was blowing, the skies were grey, and it was trying to snow. Nilkanta, the peerless, a marvellous snow-clad polyhedron-shaped mountain was hidden. Behind us was a small plain bounded by the granite cliffs of Mana, and in front, to the north-west, were masses of irregular rock and the dull dead grey of the glaciers topped with snow. It was truly a most desolate and rather fearsome scene upon which we looked before our evening meal. This outlook called for an appeal to one Whisky Macdonald and the pleasing bite of ginger tended to modify our susceptibilities. It struck me that night, gulping down hot cocoa and milk before turning in, how truly such a place fitted the conception of the old Biblical term "outer darkness."

We spent some days in these parts since Todd wished to make a reconnaissance of the glaciers and surrounding heights and obtain as much information as possible of the lie of the ground with a view to further attempts. He was now convinced of the feasibility of Slingsby's route and, should the weather become more favourable, decided to make an attempt along the same line. With these possibilities in view daily climbs were made on to the slopes and glaciers running up to Kamet, and aneroid readings of between eighteen to twenty thousand feet were registered. During these days the weather continued bad, short intervals of brilliant sunshine alternating with bitter winds approximating to gale force up above, and heavy snow-storms frequently drove us down to seek the shelter of our camp below. At this time it appeared that Todd derived comfort from the reflections that under such conditions attempts on Kamet were not humanly possible, and that any efforts at record making would be inevitably doomed to failure and possibly prove disastrous. I accompanied Todd and the Gurkhas on all the climbs and had become accustomed to the

use of the ice axe and rope, without endangering myself or the others, since the leather soles of my nailed boots had by this time become somewhat worn.

One bright morning, exploring the lower parts of the glaciers, we followed the stream up its rocky channel to a place where the dirty sand-laden water oozed out of the dull grey glaciers. On this occasion I remember remarking to Todd, " So this is the source of the Ganges, and to think we have talked of seeing this."

On this terrain Todd and his Gurkhas were at their best, and it was a revelation to me to see them coming down the steep slopes of the mountains. A shout from Todd, a challenge which was quickly taken up, when they all raced downhill at breakneck speed, with unerring step, braking on their descent by ice axe and heel on snow, shale or turf. In after years I was to see numerous varieties of tribesmen on their native formations, but the skill of these frontiersmen I have never seen surpassed.

As the weather continued bad, and no prospects of an attempt offered, we moved camp further up the Mana Pass and reconnoitred there. The havildar had learned that thar were not far distant, and we made for the place where they had been seen. Climbing to a good height, we descended slowly, carefully scanning the hillsides with binoculars. The Gurkhas spotted the thar first, and we dropped behind a hill in order to come upon the herd just behind and above them. In this we were successful, and we found ourselves within easy range of a small herd. Shooting in the face of a bitter wind, with snow-flakes falling, is not an easy performance, but Todd gave me first shot. I hit the leader and then saw Todd bring down three with successive shots. In all we bagged five, much to the delight of our coolies and Gurkhas, who saw prospects of prodigious feeds. Here we were to witness another of the havildar's feats. One of the thar had fallen off the cliffs on to a snow slide, where it remained, and none of the coolies were keen on tackling the job of recovering it, as the wall of rock rose almost vertically on each side of this snow-drift. The havildar succeeded in climbing down the rock face and lashing the thar on his shoulders, glissaded down on the snow to some masses of broken rock below, where he handed the thar over to the coolies. As he had become fouled with the beast's discharges, and had acquired a pungent goat-like odour, we requested him to keep his distance for the rest of the day.

Alas for Todd's hopes, it now became necessary for us to think of our homeward journey, particularly as possible delays on account of coolies had to be taken into consideration. We moved camp to Mana, where we met a coolie who claimed to have carried for Bruce sahib, and inquired after this officer's health. Amongst other things, he stated that the sahib was like a goat on the mountain side and that he was capable of devouring a whole sheep at a sitting. We were immensely tickled, and Todd proposed passing this on when he returned to Abbottabad.

That evening the havildar, who had been prospecting near some Thibetan

camping grounds, obtained permission to borrow a gun and, at his own request, was supplied with a single cartridge. The modesty of the latter demand was intriguing, so next morning I awaited developments, when, to my amazement, he turned up with a string of rock pigeon, either twelve or fourteen. I remember Todd commenting on the possibility of bad luck if a slaughter of thirteen of these semi-holy birds had resulted. The havildar let me into the secret. The previous afternoon he had put down a little rice in a circle of stones he had made close to some rocks and sat behind these whilst the pigeon became accustomed to him. Next morning at dawn he replaced the bait and "browned" the group of necks as they crowded together to pick the grain.

Here the cook imparted a problem in nutrition to me, namely, that if a sahib feeds exclusively on pigeon, or alternatively eats a pigeon a day, he wastes away without apparent cause and ultimately dies. At the time I entertained faint suspicions that certain of his theories might be coloured by the promptings of expediency, but I have heard this repeated in other parts of India. Since the accuracy of this observation admits of tests by actual experiment, I retail this in the event of any of my seniors feeling constrained to put it into effect.

The Bharhal Ground.

We now moved down to Badrinath, where I hoped the warmer climate might relieve a tummy trouble which, according to the cook, was due to the eating of thar; albeit by hanging he had rendered it tolerably tender and quite appetizing, and as I possessed the digestion of an ostrich, this was unlikely. Most probably, it was due to the ingestion of glacier water or the large and rapid variations in height and temperature to which we had been subjected since our introduction to these parts.

We found in Badrinath that the Rawal Sahib's agents were making efforts to relieve us of coolie trouble on the return journey, so we had prospects of a little shooting in the vicinity of Dungiri. Continuing downwards, we passed bridges of snow spanning the Alaknanda river in its narrowest parts, where it flows between high rocks. These bridges are a source of wonder and are the remains of the winter snows which block these valleys. The onset of the warmer weather leads to the disappearance of the snow, with the exception of these masses, and the erosion of the stream beneath gives rise to a bridge-like structure which is capable of carrying tremendous weights. We renewed our acquaintanceship with the sub-assistant surgeon and the postmaster at Joshimath and expressed our thanks to them for Slingsby's medicine, delivered to us on the Zaskar Range, and also for the safe receipt of mail and messages.

We now attached a shikari to our train and, re-entering the Dhauliganga Valley, we again looked upon our favourite vista of snows as we passed over Madkot. Leaving the Dhauliganga, we proceeded, in the direction of Dungiri, towards the bharhal ground, following the course of the Rishiganga.

For two days Todd, accompanied by the shikari, scoured the hills to the north of the river, whilst I, with a tiffin coolie, did likewise on the south. He sighted several bharhal, but these were too shy for approach. On my side I saw nothing on the first day. The shikari attributed this scarcity and wildness to an enormous slaughter of bharhal by the hillmen during the previous winter, when they surprised and surrounded whole herds sheltering in the small valleys, and had driven and immobilized them in snow-drifts, where they were knifed indiscriminately, converting the drifts into veritable shambles. On the second day, in company with my coolie, I climbed to a considerable height and, in the cloud, put up several small herds, but could not come up with them. It then commenced to snow and we continued to follow their shadowy forms at a distance. Taking shelter from the wind behind some rocks on a hill crest, I commenced a late mid-day snack, when all at once the coolie and I heard a patter of hoofs on the other side of our shelter. We could see nothing in the mist, but, as the wind was in the right direction, we lay perfectly quiet. Later, as it was bitterly cold and we were making no progress, the coolie tried to convey to me by signs that he had a head or toothache and wished to return to camp. When he persisted, I threatened violence if he dared to make a noise. In the late afternoon, before the sun set, as frequently happens in these parts, the clouds lifted and the sun shone forth with power and brilliance, and there on the opposite bank of the little nullah on which we found ourselves was a herd of bharhal quietly feeding.

The coolie was now all eagerness, so, creeping to the edge, with eyes streaming from cold winds and anxiety, I fired at an old sire, a grand head —too low. Putting up my sights—miss, still too low. The herd were now looking for the cause of the reports, since they had not sighted or winded us, and the old man came forward on the look-out. Crack, and I had drilled him through the shoulder and he toppled off the rocks into the nullah below. The next leader now came forward to see what had happened to number one, and, having the correct range, I brought him down with my next shot. I now had shot the two bharhal allowed in my licence, and rushed forward to see my bag. Carelessly, I approached the leader thinking he was dead, when without warning, mortally wounded as he was, with blood streaming from his muzzle, he literally projected himself over a ledge and out of sight. My following shot took no effect but as he had left a large pool and trail of blood, I considered he was virtually mine. Number two was just dying, shot through the abdomen. Of number one we could find no trace and it looked as if the earth had swallowed him up, although the coolie was certain he was quite close at hand huddled between the rocks. Looking around us, the sun was just setting, and as we had travelled far and it was doubtful if camp could be made before nightfall I had visions of trouble ahead. We started back for camp, the coolie carrying the bharhal, heavy and gorged with young green grass. Eventually it was quite dark and taking a short cut, our way

took us down a shale slide where hundredweights of shale followed our every step. The coolie's lower extremities were guarded by sacking tied gaiterwise around his legs, but the shale tore through my puttees and cut the backs of my calves. Finally, the coolie gave up, so selecting a good mark we covered the bharhal with shale to protect it from the cheels. Under a full moon we made a quick and easy return to camp to find everybody under orders to form a search party and Todd rampaging. Allowing him relief by his tongue, which I found was usually the best course, I eventually attempted a defence, but he was too angry to listen. I ate my dinner in silence and hoped to get in the explanation later, but Todd was really angry about my "thoughtless disregard for others" as he termed it. As we were moving off to bed, he told me that the shikari was under my orders on the morrow, and to my statement that I had just shot two bharhal, still in an extremely bad humour, he replied, that he was prepared to pay compensation to some poor shepherd for my shooting his goats.

Todd went off early next morning apparently still angry and I sent off the shikari and coolie for my two heads. I found I had strained my tendo Achillis on the shale, and having shot my two bharhal, remained in camp. In the course of the morning the coolie arrived with one bharhal, the smaller one, stating that a snow leopard (more likely a Bhootia shepherd) had probably removed the other. On Todd's return I persuaded him to come and see my bag. He took a snapshot of me with it, after which the bharhal was flayed and the head boiled to remove the flesh. Todd considered that his lack of success was a further example of the bad luck which had persistently dogged him ever since he had started to arrange this mountaineering expedition. The shikari stated that my bharhal was the best head that had been obtained in these parts for a couple of years and from the coolies' description of the first one, decided it must have been an old ram that he had seen with a biggish herd on several occasions, and was a magnificent head. Unfortunately we were leaving next day and time did not permit of more extended searches for this bharhal.

A Cholera Scare.

We were now on our return journey proper, and after passing Tapoban we climbed and crossed the now well-known Kauri Pass where we said good-bye to our circle of snows on which we have so frequently commented. On to Kaliaghat, Ramni and Ghat. On the way down to Kaliaghat, Todd drew my attention to the deep blue colour of the Gohna Lake. This lake had been formed by an immense landslip which had damned the Birahiganga. Subsequent erosion of the dam released an enormous flood which swept down the Alaknanda Valley and did considerable damage, but so well had the Government officials done their work that the only loss of life resulting was that of a man called the Gohna Fakir, who, despite a previous eviction, and contrary to orders, returned to his house below the obstruction and perished in the flood with his family.

In after years I was to witness a similar phenomenon after being detained in Kashmir by monsoon floods which demolished the Abbottabad route and irreparably damaged the Murree one. The bursting of the Shyok dam released flood waters down the Indus and the Attock gorge was completely filled with water imperilling the famous bridge. So great was the weight of this mighty mass that the waters of the Kabul river at the peak of its monsoon load were held up and borne back, and for a short time the current of the river opposite Nowshera was reversed.

Such are the stupendous exhibitions of energy seen in the giant regions of the Himalaya.

The Camp Kulara, near Kauri Pass.

One morning as camp was being struck I was informed that the havildar had been taken ill with cholera, but so well established was our routine that this did not interfere with progress. I, perturbed but sceptical, examined him finding that he, the lion-hearted, was leaden-coloured and terror-stricken in the presence of this invisible foe, and looked a very sick man. Providentially a subordinate forest officer happened to be encamped near, and he very kindly lent us a rough litter upon which the havildar was laid. After a good dose of castor oil, followed by arrowroot and chlorodyne, we started our double march, but despite my assurances, the havildar persisted that he would be dead by noon. At noon he was given more arrowroot and some tea and appeared much better, although he now timed his demise for 4 p.m. At 4 p.m. after more tea, he admitted that he felt better and shortly he was seen walking alongside his litter. When I looked him up in camp I found him taking a very acute interest in the naik's preparations for an evening meal.

At Tapoban we had received some mail and learned that Slingsby had made a safe passage. At one of the stages, just below Ramni, he had set out for a stroll to try his legs, with an orderly and a rifle. Within a few yards of his tent he met a full-grown bear face to face, looking at him with surprise, and he shot the animal dead on the spot. Not a bad effort for an invalid! The letter continued that we were bidden to dine with a Captain Troup, a tea planter, a local celebrity, who had become an institution in these parts and lived near Gwaldam. He hoped that we could accept the invitation which was extended to all who passed that way, and we could be assured of a hearty welcome.

THE LAST STAGES.

Our next stages were Banjbagar, Dungiri, and with the rise over Kauri and subsequent descent to the river beds, some of these marches taxed the powers of the coolies severely. Two of the valleys were filled with lush vegetation and, after the recent temperatures and exposure to severe climatic conditions, the contained air felt hot and stifling. In one valley green pigeon were seen, and as we moved off the pathway the blades of grass carrying small leeches bent towards us. A disinfestation of our dogs followed. One could not help noticing how on some of these big hills a coolie would quite frequently pick a flower from the road side, and at the end of the pull up would place it as an offering at a little rill or niche at the top. This custom appeared in keeping with one I had seen previously in Japan in the villages near Kyioto and Kamakura, and on the island of Enoshima, now unfortunately beneath the sea. Here additional offerings of food and cloth were sometimes made by coolies or maidens to the roughly carved stone images, which occasionally fill these situations, but in one instance I observed their place had been usurped by a Russian shell, which I presume could be taken as symbolical of progress.

At this time at one of the stages near Ramni was to be found a rough forest hut in the most perfect setting. Poised on an eminence in a clearing in the forest, its sweeping natural terraces looked out upon a most gorgeous expanse. This, I was informed, had been the camp of some past Viceroy, and here he had held durbar. The attraction of the place proved so great that we halted for a day and engaged a shikari who promised us at least a black bear apiece, but we failed to meet any. He also informed us that some of the Garhwal pultan sahibs used this hut as one of their shikar headquarters, and caught excellent snow trout, which had appeared spontaneously in the waters of the Gohna lake. For years I promised myself a repetition of the visit, although nowadays such a contingency appears singularly remote.

So we continued our marches through miles of primeval forest, our path lined with trees straight of stem and branches meeting overhead like cathedral aisles, or in more humid situations, with trunks encrusted with a

lichen-laden mass of fern, carried up from the lush undergrowth to a height of thirty feet or more above our heads.

Up to now, the four-footed members of our party had behaved perfectly. Todd's little spaniel had put up and retrieved many a bird which had gone the way of all good flesh. The only trouble with him had been that he required treatment after an investigation of an evil, scum-covered pool between some rocks, which turned out to be a geyser with its surface powdered with a sulphurous film. Pinkie, however, was the one which now came under displeasure. She had been restrained from attacking Bhootia mastiffs, against which, with their thick, woolly coats she would have fared badly, but she had an unconquerable aversion to the odoriferous hill coolie. It appeared that one of these had entered my tent early one morning, possibly in search of a prospective smaller load. I was awakened by a low growl and a yell from the man as Pinkie took him down the khud. He was retrieved later with a piece of his calf missing, and to avoid coolie troubles I guaranteed a complete cure and compensation. So day by day he attended me on the marches. The wound was cleansed with coloured perchloride lotion made from tablets, and dressed with purple double cyanide gauze. On these occasions he would only permit the making of the solution in a bottle produced by himself, and, thinking it was a matter of caste prejudice, I made no objection, but I also noticed that he always returned minus dressing and bandage. He healed like a wild animal, and when the day of settlement arrived, the chapprassi informed me that he would be quite satisfied if I gave him some blue tablets which were excellent for the stomach. This gave me rather a shock, which was not diminished when I learned that he had sold the odd fractions of his lotion in the neighbouring villages from day to day, together with his dressings, and had netted a nice little sum. I prevailed upon him to accept some fever medicine (quinine) in lieu, and he ultimately departed with some No. 9 pills and quinine tablets.

We now arrived at Gwaldam Dak Bungalow, the first of a series of rest houses on our final marches, and lo! and behold, the bedroom contained a single bed, the only one we had seen for many a long day. We tossed for it, and Todd won. "That is as it should be," he remarked. "You could not expect the only bed and the only bharhal." My bed was made up on the floor and I was awakened in the night by the striking of matches and lighting of lamps, to find Todd tearing his pyjamas off, and to see his rather white skin absolutely covered with highly irritable blotches, looking like a bad case of chicken-pox. Bugs—hundreds of them!! My attempts to stifle an irresistible outburst of laughter with the bedclothes proved so disastrous that at the later halts, during the morning and evening searches, I endeavoured to be absent, since my presence only reminded him of my helpless hysterical paroxysm on this unhallowed night. I believe it was not until our second morning at Bhim Tal, at the end of our trip, that the havildar and naik confided in me that no more had been found that day.

In accordance with Slingsby's request, we called upon Captain Troup and remained to dinner. This officer, a Mutiny veteran I believe, was now tied to a bath-chair, and obviously his span of life could only be reckoned in months. His venture in tea-planting had not proved a success, and the fine old man was living in a very full past. On his walls were grouped hill trophies which bore silent testimony to a prowess of no mean order, which scarce could be equalled in any Gurkha or Frontier Force Mess. He was a genial host, and the conversation chiefly turned on anecdotes connected with Bruce, Longstaff, Kellas and others whose names were bywords in the mountain regions. When we took our leave, our host thanked us for our visit, since now his field of amusement was very much curtailed, and he regretted that the number of travellers along the road was diminishing. Promising to repeat out visit at an early date, we now passed on to Baijnath, Someshwar, Hawalbagh and skirting Almora, we continued due south via Satkall and Ramgarh to Bhim Tal. Here we made a final halt of two days to sort out kit, and walking around the lake we met the first reminder of work and duty in the person of a British soldier fishing. One final march and we took train from Kathgodam for the north, Todd for Abbottabad, and I for Ambala, where an epidemic of dengue was raging, in which my energies were quickly absorbed in the usual channels.

Lieutenant A. M. Slingsby made a perfect recovery, obtained his promotion, and became Adjutant to his Regiment in the following year. On March 8, 1916, he was killed in action in Mesopotamia and awarded a posthumous Military Cross.

Captain O. E. Todd did not survive his friend long. He died on July 10 of the same year and lies buried at Abbottabad, on his beloved Himalaya, and I believe that to the end he was served by the faithful naik, Chunder Singh.

If through the lapse of years I have erred in some minor topographical or chronological detail, I crave indulgence. To the heroes of "Kamet Conquered" I tender a grateful tribute, since in the vivid descriptions of its pages and the beauty of its photographs, I have lived again a leave of long ago. Lastly, to all wayfarers who have travelled these time-worn paths to the fadeless snows and have held close commune with Nature—Salaam!

Postscript.—This article would not be complete without acknowledgments to Colonel G. S. C. Cooke, D.S.O., of the Ordnance Survey Department, who interested himself in the routes, went to a considerable trouble in making inquiries regarding maps and obtained the necessary permission for the utilization of maps of the Survey of India, also to Major-General H. C. R. Hime, D.S.O., K.H.P., Deputy Director of Medical Services, Southern Command, who suggested the writing up of this attempt and whose kindly criticisms have been of great assistance.

Editorial.

THE ERADICATION OF BOVINE TUBERCULOSIS.

THE fact that bovine tuberculosis may readily be transmitted to human beings, and especially to children, through the drinking of infected milk, was foreshadowed by Creighton in 1881, and established by the Royal Commissions on Tuberculosis.

Following on the findings of the Royal Commission of 1904-11, the provision of a pure milk supply became one of the ideals of preventive medicine, and to attain this eradication of bovine tuberculosis was regarded of the first importance.

The losses caused by bovine tuberculosis to the agricultural community and the losses to the country through the occurrence of human tuberculosis of bovine origin are enormous.

In an important report on the eradication of bovine tuberculosis, just published by the Medical Research Council, Dr. L. Jordan discusses the losses to the agricultural community due to advanced disease and depreciation of stock. He estimates the total losses in condemned home-produced meat due to bovine tuberculosis, including animals slaughtered under the Tuberculosis Order, at about £750,000 per annum. He considers that the eradication of bovine tuberculosis would reduce these losses to negligible proportions.

A few years ago it was assumed that the bovine type of tubercle bacillus is only found in non-pulmonary infections. But Griffith and Munro have recently shown that the bovine type is responsible for a high proportion of cases of pulmonary tuberculosis. In Scotland they have identified the bovine type in 3·8 per cent of pulmonary cases.

Dr. Jordan states that taken over all it is estimated that approximately 2,000 deaths each year are directly attributable to human tuberculosis of bovine origin and that 4,000 fresh cases of bovine infection occur annually. If only one-third of these cases receive sanatorium treatment, as seems probable, the cost would be £500,000 a year; so that if bovine tuberculosis could be eradicated the saving to the country would be more than £1,000,000 a year.

The present infection of the milk supply has been investigated by numerous observers. Wilson and his colleagues made a survey of tuberculosis of bovine origin in Great Britain and quote figures for the infection of the milk supply from different cities which vary from 2·9 to 11·1 per cent. Dr. Jordan does not think such wide variations could be attributed to differences in the proportion of infected cattle in various localities. He considers that these different results may be attributed to differences in technique employed for the detection of tubercle bacilli in the various

centres and to the degree of bulking to which the milk has been subjected prior to sampling. The figures previously given with regard to the proportion of individual reacting cows which excrete tubercle bacilli in their milk have been based on the number of cases of udder tuberculosis found either by routine veterinary inspection of the intact animal or by post-mortem examination at abattoirs.

Savage estimates the proportion of infective udder cases at not less than 0·2 per cent of all dairy cattle. Gofton found that 0·73 per cent of the cows slaughtered at the Edinburgh abattoirs showed microscopically recognizable lesions.

In the course of his investigations Dr. Jordan examined samples of milk from 636 individual reactors; he found nine positive samples, giving a proportion of 1·4 per cent. As a control 60 milk samples were taken from non-reacting cows and subjected to a similar biological test; there were no positive cases. These results indicate that about 1·4 per cent of reacting cows secrete living tubercle bacilli in their milk. In this investigation clinically tuberculous animals were excluded, all the samples being taken from cows which would normally pass a routine clinical inspection, such as that carried out under the Milk and Dairies Act. Though the proportion of reacting cows which excrete tubercle bacilli in their milk may be small the percentage of infected samples taken from the mixed milk of individual herds will be largely increased. The milk from one tuberculous udder may infect the whole of the milk from a large number of cows. This was found to be the case in Scotland where a recent inquiry showed that the infection of raw milk arriving in cities from herds of a comparable size was 16 per cent. A still higher proportion is found if samples are drawn from the bulked milk contained in receiving tanks at creameries. Dr. Jordan examined 267 samples of such bulked milk and 37·5 per cent were found to be infected.

A report on the tuberculous infection of milk by the Department of Health for Scotland was issued in August, 1933, and has been published by the Medical Research Council. The report deals with the milk supplied to Aberdeen, Dundee, Edinburgh and Glasgow. The liquid milk consumed in these cities comes from four sources: (*a*) From farms which consign the milk in churns to distributors in the cities either direct or through creameries in the dairying districts; (*b*) from creameries where the milk is run into large tanks for transport to the distributors in the cities; (*c*) from small dairy farmers who produce the milk and retail it direct to the consumers; (*d*) a comparatively small quantity of graded milk which arrives in bottles or cans. In Glasgow a considerable quantity of milk is transported in large tanks from the creameries, and in Edinburgh a large part of the city's supply is derived from dairy byres within the city boundaries.

In testing the milk for the presence of tubercle bacilli duplicate samples of 50 c.c. of the well-mixed milk were centrifrugalized and

the deposit from each tube was suspended in 3 c.c. of sterile normal saline solution ; 3 c.c. were then injected into each of two guinea-pigs. One guinea-pig was killed at the end of four weeks and the other examined at the end of eight weeks, if the first guinea-pig was negative.

The tests show that the proportion of infected samples of the raw milk in churns is roughly 10 per cent. The incidence of infection increases with the volume of the milk from which the sample is taken. There were no seasonal variations in the incidence. Raw milk transported in tanks shows a heavier proportion, 37·5 per cent of infected samples.

There was only one positive case in over 700 tests of graded milk. This sample was taken from the bulked sample of the whole herd and it was found that inadequate means were being taken to protect the herd from infection by direct contact with neighbouring stock.

Some of the milk arriving in the cities is heat-treated. With the flash method of heating the percentage of infected samples was 8·2 ; but with the holding method only 2·8 per cent were found to be infected. Heat treatment involves bulking to a varying degree and these results should be compared with the samples of raw milk taken from tanks, which were found to be infected in the proportion of 37·5 per cent.

The examination of samples of milk as exhibited for sale to the consumer showed 9·91 per cent to be infected, much the same result as that previously noted for the raw milk. The incidence in individual cities varied from 7·4 in Dundee to 14·3 per cent in Edinburgh, where few of the samples were previously subjected to heat-treatment. It was difficult to ascertain the proportion of heat-treated samples in the milk supplied for sale in the cities, and the number of samples taken was not representative of the proportions of untreated and treated milks actually retailed. An attempt was made to correct for this factor, and it is estimated that the general rate of infection of the total quantity of milk retailed in the four cities is considerably lower than 10 per cent and probably little more than 5 per cent.

The two chief measures which have been adopted in this country with the object of limiting the spread of bovine tuberculosis are the Tuberculosis Order of 1925 and the Milk (Special Designations) Order of 1923. The aim of the Tuberculosis Order was to eliminate the advanced cases of the disease by means of the compulsory notification and subsequent slaughter of certain classes of infected animals. This Order has failed because the notification of clinical reactors has not been sufficiently prompt to prevent the dissemination of infection before their removal from the herd. It has been found that the proportion of reactors in herds from which animals had been removed on clinical grounds reached the striking figure of over eighty per cent. Fowler and Wright have given a number of clear-cut instances where cows in an early stage of the disease have conveyed infection to their stall-mates. Another reason for the failure of the Order is the impossibility in many instances of detecting an animal giving tuberculous milk by manual examination of the udder.

The first stages of udder tuberculosis, when tubercle bacilli are present in the milk, are not detectable by clinical examination.

The Milk (Special Designations) Order of 1923 was enacted with the object of encouraging the voluntary eradication of tuberculosis from individual dairy herds, and of enabling high-grade milk from such herds to secure a place in the market. It has been effective in a limited number of dairy herds. The average proportion of cows which react in untested herds is about 50 per cent, but Fowler and Wright in a careful survey of licensed tuberculin-tested herds in Scotland found that the average number of reactors in these herds is about 1·5 per cent. Dr. Jordan examined 714 samples of milk from licensed tuberculin-tested herds in Scotland using a stringent technique and employing duplicate guinea-pigs for inoculation; of the samples examined only one proved positive, and it was subsequently ascertained that this was attributable to careless management on the part of the owner of the herd.

Unfortunately, the cow population of all the licensed tuberculin-tested herds in Great Britain in 1931 amounted to 22,500, only about 0·5 per cent of the total cow population of the country. The growth of such herds is extremely slow because of: (*a*) The considerable cost to the owner in tuberculin testing, in the payment for licence and other miscellaneous expenses; and (*b*) the poor demand for graded milk.

At present, therefore, it is considered that the Milk Order of 1923 cannot play any considerable part in effecting widespread tuberculosis eradication, unless adequate incentives are made available to encourage the establishment of tubercle-free herds.

The need for the eradication of bovine tuberculosis being apparent, Dr. Jordan carried out for the Medical Research Council an experimental scheme in Scotland. Before commencing work on the scheme he made a survey of the methods of eradication employed in other countries. There appear to be three chief methods, viz., Ostertag's, Bang's and the slaughter method.

In Ostertag's method, chiefly used in Germany, reliance is placed solely on clinical examination to discover cases of the disease, and on the feeding of calves with milk sterilized at 85° C., or with raw milk from cows free from tuberculosis. Weaned calves are tuberculin tested and reactors slaughtered. This method is in effect based on the same principles as the Tuberculosis Order and is unlikely to effect any tangible reduction in the incidence of disease.

In Bang's method all animals in the herd are clinically examined and any showing evidence of tuberculosis are condemned and slaughtered. The remainder of the herd is then tuberculin tested. Reactors are separated from non-reactors. Young stock have quarters of their own. Separate attendants are kept for each unit. Newly acquired animals must under no circumstances be added to the free herd unless they have been found free from evidence of tuberculosis. Clinical evidence of tuberculosis in a reactor

serves as the signal for its immediate disposal, preferably by slaughter. The free herd should be re-tested with tuberculin every year.

The slaughter method is the most effective, but is correspondingly more expensive. It involves the tuberculin testing of all bovine animals, and the immediate slaughter, with compensation, of all reactors. This method has proved very successful in America, but is impracticable in England at the present time as it would involve enormous expenditure and cause a serious shortage of stock.

After examination of the different methods of eradicating bovine tuberculosis, Dr. Jordan came to the conclusion that Bang's method or some modification of it might offer the best opportunities for successful application in this country.

For the experiment an area in Ayrshire, containing thirty-seven farms, was selected. Three owners of farms refused to take part in the scheme, and two others already possessed licensed tuberculin-tested herds and could not therefore be included in the experiment. The herds were essentially milking herds, the produce being sold as liquid milk. The basis of eradication was the provision of free tuberculin testing and of free advice on methods of isolation and on the rearing of young stock. Where possible, reactors were subsequently housed separately from non-reactors. Valuable reacting cows were retained until after calving and were then sold. Calves from reacting dams were fed on non-reactor's milk. Every herd was re-tested with the tuberculin test at six-monthly intervals. Special care was taken to keep the young stock free from infection. Very few animals were bought in, and these were tested before entering the area.

The experiment lasted for three years. Twenty of the herds were found free from infection at the final test and eight others showed substantial progress. A general improvement was shown among the stock in all the co-operating herds ; the improvement enhanced the value of the stock, and there was an increased demand for animals from the tubercle-free stock. On the other hand, the demand for tubercle-free milk was disappointing. The cost to the owners was small and more than offset by the increased value of the stock.

The main sources of infection in the herds were contaminated premises and pastures, and infection from direct animal contact was not infrequent. The danger of clinically tuberculous animals as foci of infection was confirmed. Infection from bought-in cattle was rare since the herds were largely self-supporting.

The work of Dr. Jordan shows clearly what can be achieved by providing the relatively small incentives of free tuberculin testing and free expert advice. In 1919 the Astor Committee recommended that " facilities should be provided out of public funds for free tuberculin testing, provided that the farmer can supply evidence that he has reasonable facilities for carrying out the tests, and is willing to comply with the necessary conditions laid down for freeing his herd from reactors."

Dr. Jordan's report re-directs attention to these proposals.

Clinical and other Notes.

EXTRACTS FROM A REGISTER OF SURGICAL OPERATIONS.

By Major W. L. E. Fretz,
Royal Army Medical Corps.

(*Continued from p.* 58.)

(c) *Ectopic Kidney.*

The patient was admitted complaining of pain in the right side. He had had a previous attack and the pain, though not very severe, had seemed to go round to the back.

On examination his temperature was 100° F. and pulse 90; there was tenderness and rigidity on the right side of the abdomen and a tense painful mass was felt at the level of and to the right of the umbilicus. This was thought to be possibly a matted omentum or an appendix abscess, and immediate operation was undertaken. A gridiron incision having been made the appendix was found lying in the ileo-cæcal pouch, but only showing signs of a subacute infection. On exploring the upper end of the wound the mass noted prior to operation could be felt and the lower edge seen. The wound was extended upwards by separating the aponeurosis from the rectus sheath and on passing the hand into the abdomen upwards, the mass by its pulsating pedicle was recognized as being a kidney. As the possibility of nephrectomy had not been considered and as this would have been well nigh impossible with the incision already made, it was decided to close the abdomen and investigate the renal efficiency, prior to further operation. The patient made an uninterrupted recovery, but developed bouts of pyrexia with pains in the back at intervals of about ten days, lasting thirty-six to forty-eight hours, being perfectly well between the attacks.

Twenty cubic centimetres perabriodol were given intravenously, and a pyelogram taken fifteen minutes later showed a picture of the pelvis of the right kidney and the first part of the ureter on the right side in the normal position. There was a shadow in the area of the tumour but no evidence of secretion of the perabriodol. There was no kidney shadow on the left side. This was rather surprising as the misplaced kidney found at operation was thought to have been that of the right side. Patient was given an injection of 0·4 per cent indigo-carmine and cystoscoped. Examination showed the dye appearing in four minutes from the right ureter, but there was no sign of any excretion from the left, the orifice of which appeared normal. Ureteral catheterization was not done as he had a fairly severe reaction with fever for two days as the result of the cystoscopy, and any further

information likely to be obtained thereby would not have compensated for any possible damage due to further manipulation. As the patient was anxious "for something to be done" for his constant backache and his blood urea examination showing a normal 40 milligrammes per 100 cubic centimetres, it was decided to remove the abnormal kidney, his symptoms being probably due to back pressure effects of the healthy kidney.

A right para-rectal incision was made and the tumour exposed; as it lay to the medial side of the ascending colon and to the right of the aorta the peritoneum was incised over it and the tumour freed by gauze dissection.

The vessels were found entering at the upper end and were ligatured. The ureter was found emerging separately from the lower pole and was dealt with; an accessory artery and vein found entering and leaving at the upper and outer side were ligatured, leaving the organ free. The right ureter was seen in its normal position and as there was no apparent bleeding the incision in the peritoneum was stitched and the abdominal wound closed.

The removed kidney showed typical fœtal lobulation and on section no differentiation between cortex and medulla could be seen. It was sent to the laboratory for further investigation.

A similar case operated on for appendicitis is described in "Emergency Surgery," by Hamilton Bailey, F.R.C.S., vol. i, p. 283, with this difference, that in his case the kidney was a right one which had never got up to the loin, while in the case described here the kidney was a left one on the right side. How it got there I do not know! The patient is now convalescent, passing on an average forty ounces of healthy urine a day, and has lost all his symptoms.

This was an interesting case in that the condition found at the second operation coincided with the surprising findings elicited in the renal investigation.

I was fortunate in having the assistance at the operation, of Major Sargood Fry, F.R.C.S., I.M.S., Civil Surgeon, Murree, whose interest in the case and advice were of great help.

(5) Blood Transfusion in Puerperal Septicæmia.

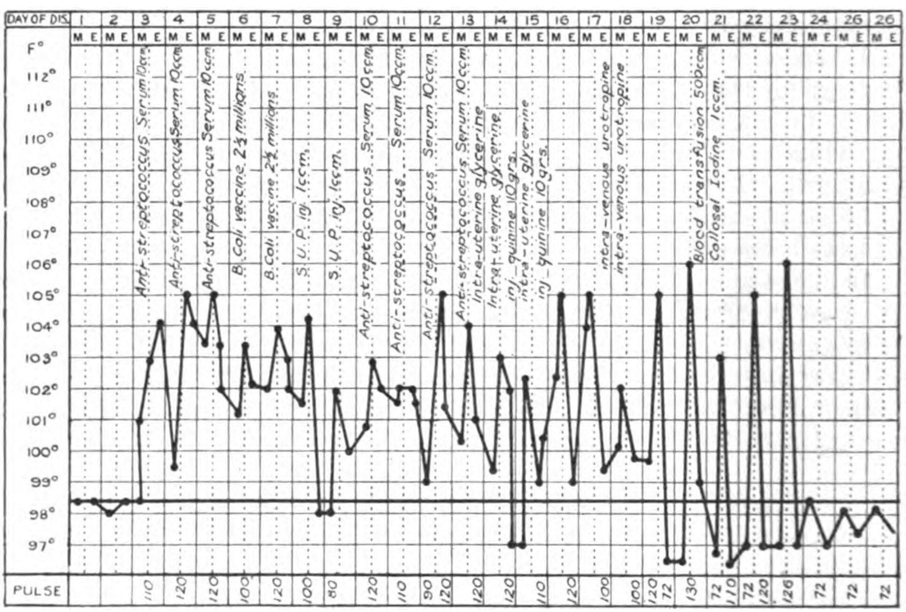
A letter in the *British Medical Journal,* dated April 15, 1933, in which it is pointed out that "the mortality from acute puerperal infection is still high and that no specific treatment is yet available," suggests the publication of the result of treatment by blood transfusion of the following two cases. The method may or may not be new, but in these two cases the results were so satisfactory, in fact so dramatic, that I would suggest this is a line of treatment which might be investigated by those specialist officers who have more opportunities of dealing with such conditions.

Case I.—The notes on this case are from memory as it occurred about three years ago.

There had been manual delivery of the placenta under difficult conditions,

and although the patient had been given anti-streptococcus serum at the time, she developed pyrexia and signs of puerperal infection on the fifth day. Temperature rose rapidly and the discharge became fairly profuse and offensive. In spite of intra-uterine glycerine douches, and intravenous collosal iodine, anti-streptococcus serum, etc., the temperature continued for over a week at about 106° at night and never below 100° in the morning. Blood culture was performed about the ninth day and a short-chained streptococcus was isolated. Patient was given 500 cubic centimetres citrated blood on the tenth day of illness with 50 cubic centimetres anti-streptococcus serum. On the twelfth day the temperature fell to normal and remained so. Another transfusion was given on the fourteenth day, whereafter her convalescence was uneventful except for the formation of two pyæmic abscesses, one in the arm and the other in the labium, which were evacuated and healed up.

Case II.—Having been asked to see a case of toxæmia in the Cantonment Hospital, Rawalpindi, thanks to Dr. A. Burrows, whose case it was, I am able to attach a copy of the temperature chart with notes thereon.



Temperature Chart (extracted from a four-hourly chart).

At first it was thought that the puerperal condition was complicated by a bladder infection with a possible pyelitis, as a coliform organism had been grown from the urine. The patient was therefore treated with 5 cubic centimetres of 40 per cent. urotropine intravenously on three occasions, but this had little or no result on the pyrexia, neither did colossal iodine nor intra-uterine glycerine douches lead to any improvement. A blood culture

on the eighteenth day of the disease was sterile. She was given 500 cubic centimetres citrated blood on the twentieth day and the temperature fell to normal on the twenty-third day and remained so for the rest of the convalescence.

Blood transfusion is recognised as a method of treatment of sepsis, and it was this fact that prompted its use in the two cases described. Whether or not the method has been tried before and found wanting, I cannot tell, as I have no reference library at my disposal; but at any rate it can do no harm!

In conclusion I have to thank Lieutenant-Colonel A. D. Fraser, D.S.O., M.C., R.A.M.C., Commanding British Military Hospital, Rawalpindi; and Major C. McQueen, M.C., R.A.M.C., Commanding British Military Hospital, Murree, for permission to forward these notes, which though admittedly sketchy in character are intended more in the nature of a *petite causerie* than as a serious contribution to surgical literature. I must also acknowledge my indebtedness to the surgical team: Major L. Handy, R.A.M.C., Specialist in Anæsthetics, Miss M. Bremner, Q.A.I.M.N.S., Sister-in-charge, and Corporal J. Duffy, R.A.M.C., operating room attendant.

RÉSUMÉ OF AN ANALYSIS OF "EFFECTS OF HEAT" CASE SHEETS FOR 1932.

By Captain J. S. McMILLAN,
Indian Medical Service.

For convenience, and not because there is any hard and fast dividing line, cases in this analysis were classified into four groups, of which the principal symptoms (as recorded on the year's case sheets) are tabulated.

I. Cases with no pyrexia. Total cases ninety-one. Deaths nil. Thirty-one cases with less than two years' service. These are the "heat exhaustion" type of case.

	Skin		Vomiting	Nausea	Head-ache	Giddi-ness	Abdo-minal pain	Cramp in limbs	Semi-conscious	Un-conscious	Drowsy	Excited
	Cold	Dry										
%	25	4	30	25	43	25	25	28	4	2	8	1

In this class thirteen cases which were really severe had the following symptoms:—

	Skin cold and clammy	Vomiting	Nausea	Headache	Giddiness	Cramp in limbs	Semi-conscious	Un-conscious	Excited
%	92	92	23	62	23	69	8	31	8

The condition of the patient is one of shock and collapse, with considerable gastric irritation.

II. Cases with moderate pyrexia throughout. Number of cases fifty-three. Deaths nil. Pyrexia ranged from 99·6° F. to 104° F.

The principal symptoms were as follows :—

	Skin dry	Vomiting	Nausea	Headache	Giddiness	Cramp in limbs	Semi-conscious	Mental symptoms
%	66	25	13	75	21	21	2	4

Gastric irritation was not so severe in this type of case. The patient was frequently indefinite as to his symptoms. The possibility of an underlying cause for the condition other than "effects of heat" should not be overlooked.

III. Cases at first apyrexial which after a definite illness develop pyrexia.

From the practical point of view, this was a very important group. Sixteen such cases occurred, of whom nine died.

A tabular analysis of symptoms has not been made, but the following points are noted.

Apyrexial Period.

(*a*) Condition of the Skin.—Textbooks frequently cite absence of sweating with a hot dry skin as an important prodromal sign. As far as the case sheets under review were concerned, it was not specially noted that the skin was hot and dry, or cold and clammy.

(*b*) Gastric Symptoms.—Constant and distressing vomiting was a striking symptom which was absent in only one of the sixteen cases.

(*c*) Mental Symptoms.—These were marked and characteristic. The patients were very dull, or very irritable and restless. Many showed a "disrespectful" or even insubordinate attitude, and on reliable authority were said to be quite unlike their normal selves.

(*d*) Cramps in the limbs and muscular twitchings occurred in some cases.

(*e*) Giddiness was also frequently present.

Pyrexial Stage.

In the majority of cases attention was directed to the onset of this phase by some strange behaviour on the part of the patients. In all but one case they soon became semi-conscious or unconscious. The temperature at this stage varied from 100·8° F. to 109·8° F. The higher temperatures did not indicate a graver prognosis. The skin now was always dry and hot.

The duration of the apyrexial stage prior to the onset of hyperpyrexia affected the prognosis. The longer it lasted, the worse was the outlook.

In general, soldiers with two years' service and under were more severely affected than older soldiers.

The symptoms corresponded to those described in the next class.

IV. Cases with hyperpyrexia on or shortly after admission:—

Twenty-five cases; two deaths. To these must be added four cases which died, two prior to admission and two immediately on admission, which were almost certainly heat-stroke cases.

Of the twenty-five cases, fifteen had less than one year's service, four had between one and two years' service and the remainder over two years' service.

There was no doubt that these cases were similar to those in Class III, but with a negligibly short apyrexial phase.

Such cases had a dry and hot skin with a gritty feel. The face had an anxious expression and there was extreme restlessness. Vomiting (12 per cent), muscle spasm (24 per cent), and muscle cramps (20 per cent) were present in a proportion of cases. Unless treated, they quickly became unconscious with stertorous breathing, The majority of cases were, however, amenable to treatment.

A review of these classes shows clearly that they represent varying degrees of the same condition, there being a preliminary phase during which hyperpyrexia may or may not supervene. The earlier the hyperpyrexia appears, the better the prognosis. A very important practical point is that the "delayed" case gives warning by his severe gastric symptoms and peculiar mental condition.

Ætiology.

The underlying cause of hyperpyrexia in these climatic conditions is failure of the heat regulating mechanism, so that the body becomes heated above normal by the surrounding atmosphere.

Any toxic condition which upsets the heat-regulating mechanism therefore tends to produce hyperpyrexia. The most notorious cause of this nature is of course malaria, the possibility of which should invariably be carefully considered.

The true "effects of heat" case, however, is primarily referable to prolonged exposure to high temperatures without the coexistence of any infective condition.

Constipation, as is well known, is almost constantly present.

It is suggested that the prolonged excessive sweating results in deficient kidney action and an accumulation of waste products which have a toxic action—in other words, in a condition of dehydration. The muscle cramps and twitchings which occur in many cases support this hypothesis. Treatment based on this view has given satisfactory results.

The patient's bowels should be cleared and as much fluid as possible should be given with a view to stimulating kidney action and getting rid of waste products.

It will be recalled that Class III cases (which show the highest mortality) have persistent vomiting as a predominant symptom, while

Class IV cases unless treated become unconscious. In these, fluid must be given rectally, subcutaneously or intravenously. Isotonic glucose and saline per rectum in small quantities at frequent intervals (4 to 6 ounces hourly or two hourly) was found to be readily absorbed and acted well in certain cases where it was tried. Quantities up to two pints may be given rectally, but with this volume there is always the danger of reflex rejection, and where these larger quantities are indicated, they are best given subcutaneously or intravenously.

By whatever route administered, fluids should be pushed until evidence of kidney action is given by a distending bladder.

Hyperpyrexia when present should be reduced by sponging, cold baths, etc., but this treatment should not be carried to the point where collapse supervenes, the object being not so much to reduce the temperature *per se* as to keep it within reasonable limits while treatment to remove the cause is being applied. Gentle cold sponging with steady friction of the skin in the hope of inducing sweating is advocated.

Sedatives are of great value, and bromides per rectum, or morphia and hyoscine hypodermically, have been found to act well. Camphor and strophanthus are useful cardiac stimulants. Chloral hydrate and strychnine are to be avoided.

Venesection and lumbar puncture may relieve the symptoms in certain cases.

NOTES ON A RECENT EPIDEMIC OF MEASLES.

By Major I. H. LLOYD-WILLIAMS, M.C.,
Royal Army Medical Corps (T.A.).

The epidemic occurred at Catterick during the months of December, 1931, and January, 1932. In all one hundred and nine children were seen by me during this period, no cases occurring among adults.

Certain clinical observations were made which are considered worthy of record.

The age incidence was as under :—

Under 1 year	.. 2		Under 6—7 years	.. 17
1—2 years	.. 12		7—8 ,,	.. 13
2—3 ,,	.. 7		8—9 ,,	.. 12
3—4 ,,	.. 6		9—10 ,,	.. 13
4—5 ,,	.. 6		10—11 ,,	.. 2
5—6 ,,	.. 18		11—12 ,,	.. 1

It is noticeable from the above that there would appear to be a relative immunity during the first year of life: the youngest case I saw was 5 months old. The second year produces a fair number, followed by a drop and a higher incidence of the first five years of school life attributable to increased risks of infection.

Preventive measures are always difficult to enforce on a civilian or semi-civilian population such as these cases, which were among the married families.

Clinically there were several cases, about four in number occurring in otherwise infected houses, of what Osler described as *Morbilli sine Morbillis.* These patients presented the usual catarrhal symptoms with pyrexia but no exanthem or only a very slight and indeterminate one.

Towards the end of the epidemic, the cases became more severe, the pyrexia being higher and the rash more confluent; no cases of hæmorrhagic cutaneous eruption were observed. Some of the worst ones exhibited hæmorrhagic maculæ on the pharynx, soft palate and fauces surrounded by a red areola; these patients complained of sore throat, whereas the others had not done so.

Another unusual symptom synchronizing with the cutaneous eruption was diarrhœa. This was characterized by watery stools and abdominal discomfort; distension was not marked; blood and mucus were not seen in the fæces. The condition was relieved by bismuth. I have not seen this described in any textbook and it was presumably due to an intestinal catarrh and possibly to an eruption similar to that observed in the pharynx. The stomach seems to have been unaffected as there was no sickness or hæmatemesis.

The only complications met with were one case of bronchitis and one of bronchopneumonia, which commenced on the tenth day.

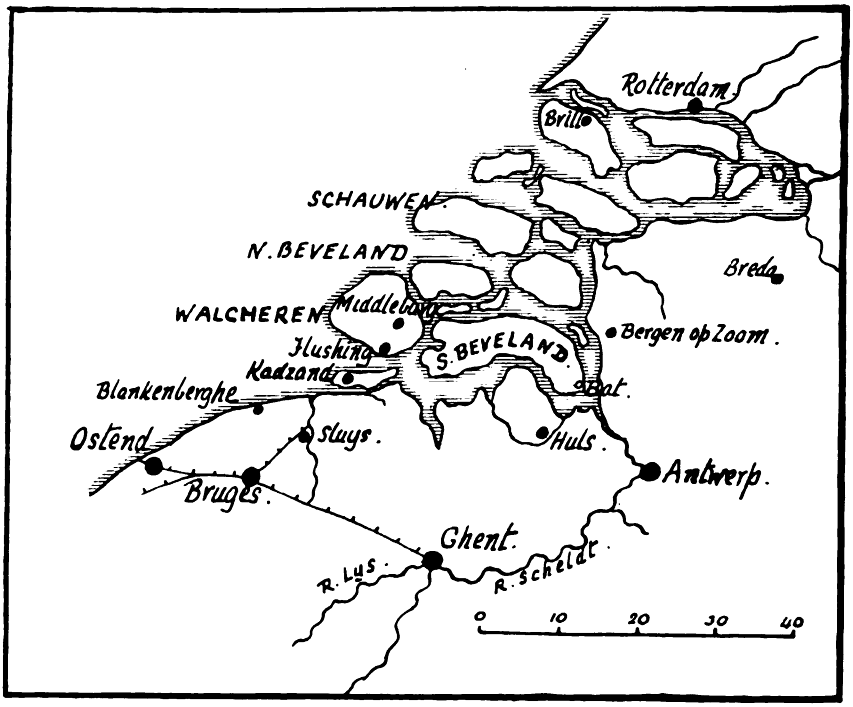
Echoes of the Past.

THE WALCHEREN EXPEDITION AND THE REFORM OF THE MEDICAL BOARD, 1809.

By Lieutenant-Colonel G. A. KEMPTHORNE, D.S.O.,
Royal Army Medical Corps (*R.P.*).

While Sir John Moore was engaging Napoleon's attention in the Peninsula the Austrians were preparing to re-enter the war. It was now decided to maintain the defence of Portugal with 30,000 men and to send a strong expeditionary force to capture Antwerp, destroy the naval base which Napoleon was forming there for the invasion of England, and at the same time create a diversion in favour of our allies. The plan was sound, but its success depended on the promptness, secrecy and vigour with which it was carried out, none of which conditions was fulfilled. The great armament of 40,000 men was assembled in the Downs in July, 1809. The Earl of Chatham commanded the troops, Sir Richard Strachan the fleet. The main body disembarked on the Island of Walcheren on July 30

under unfavourable weather conditions. The division which should have landed at Blakenberghe to destroy the batteries at the southern entrance of the river could not be put on shore owing to the surf. This necessitated the reduction of Flushing before the fleet could enter. The town held out until the 14th. Meanwhile the whole of South Beveland had been occupied, but by August 25, when the troops had been brought up to Fort Bat at the eastern end of that island, the French had collected such a force round Antwerp as to preclude the possibility of a successful attack. A further reason for declining further active operation was the increasing sick list. Fever had appeared ten days earlier, and on the 29th Lord Chatham reported



a little under 3,000 in hospital. The scheme was abandoned. On the 30th, seven brigades were sent to reinforce the garrison of Walcheren, taking their sick with them in wagons. The remainder, with the Commander-in-Chief, sailed for England on September 5. Two days later the sick of the whole Army, including those on the way home, were reported as 11,000.

The epidemic of sickness was a factor in stopping the attack on Antwerp, though not apparently the main one. The difficulties of the passage up the river had been underestimated and the weather had upset the time table; success demanded a certain amount of luck, and the luck failed. It was the deciding factor, however, in the final withdrawal of the garrison from Walcheren.

The Inspector of Hospitals, Mr. John Webb, in a report dated September 11, stated that the sickness appeared as a low fever, but subsequently took on a form similar to jail fever. This was especially noticeable among the regiments recently returned from Spain. From other reports we learn that it was a "marsh-fever, continuous, remittent, or intermittent, quotidian, tertian, or quartan, disposing patients to dysentery, pulmonary affections, and visceral obstructions, particularly of the liver and spleen, and followed by prolonged or permanent weakening of the constitution." An officer who suffered from it described it as "unstringing every muscle, penetrating every bone, and searching and enfeebling all the sources of mental and bodily life." He dragged it about with him for years. The origin was ascribed to the nature of the ground over which the Army operated. The islands were mainly reclaimed land, little better than a swamp, and the ditches were filled with putrid vegetable matter, while the quantity of pure water was very limited. The inhabitants are said to have been notoriously unhealthy, the sickly season commencing in the middle of August and terminating with the winter frosts. That the greater part of the Army was infected with malaria cannot be doubted, and had the medical authorities been informed beforehand of the destination of the expedition, they could have warned Lord Castlereagh that he was despatching it at the worst season of the year, for the reputation of the place and the seasonable prevalence were well-known. In a disease of such protean manifestations we may well hesitate to question the diagnosis of the day. But the various clinical descriptions suggest that the term Walcheren fever embraced other febrile affections besides malaria. In Sir John Moore's regiments which took part in the campaign, the seeds of typhus, and it may well be also of trench fever, still persisted. When, moreover, an army bivouacks on swampy ground, which serves both for the supply of drinking water and as a conservancy trenching area, enteric fever is to be expected. This probably played its part in the high mortality.

The original medical staff despatched included Inspector John Webb, Deputy Inspectors Francis Burrowes, J. R. Grant and G. S. Avening, 5 Physicians, 18 Staff Surgeons, 2 Apothecaries, 3 Purveyors, 4 Dispensers, and 30 Hospital Mates. Most of the regiments had 2 surgeons. A party of 50 men of the Royal Veteran Battalion was sent for duty in the general hospitals. Hospital bedding and clothing had been asked for by the Surgeon General for five per cent of the force; in addition the regimental establishments had their own. The "Asia," 480 tons, had been fitted up as a hospital ship and there were two transports for convalescents.

Some 16,000 men remained in Walcheren under command of Sir Eyre Coote. Of these, on September 10, 220 officers and 8,095 men were reported as sick. The troops had gone into close billets at Middleburg, where the two civil hospitals and the commodious store houses of the East India Company were taken up as general hospitals. Flushing was also a hospital centre. The accommodation remaining after the bombardment was

cramped, dirty and overcrowded. At Veere, considered to be the most healthy site on the island, the church was used as a hospital. Demands were sent home for more drugs, medical equipment and doctors. Meanwhile a supply of bark was procured by the purchase of an American ship's cargo. Natives were engaged as sick attendants on a scale of ten per regiment. On September 30 there were present 15 staff and 35 regimental surgeons, with 25 mates. Inspector Webb had been invalided, and, on September 29, Deputy Inspector James McGrigor arrived in his place. He advised that the guns should be removed from four of the men-of-war, and as many patients as possible sent home in charge of the naval surgeons. A return of October 12 showed the total sick as 9,614 and the deaths per week as 218. A little over half the sick were fever cases. By the 22nd 4,000 men had been evacuated, but 6,425 remained in hospital. On October 16, out of 54 medical officers there were 23 fit for duty.

Meanwhile the Government decided to send out a Medical Commission, and nominated the Physician General and Surgeon General as members. The former naively confessed that he was unacquainted with the investigation of soldiers' diseases in camp and quarters, the latter seems to have replied that it was a physician's job, and the Inspector of Regimental Hospitals made the same excuse. Messrs. Keate and Knight might have justly urged, as perhaps they did, that their time was fully occupied in finding accommodation for the invalids sent home. At any rate the evasion of the duty by the members of the Board was not well received. The Commission as finally constituted included Sir Gilbert Blane, formerly Surgeon to the Fleet under Lord Rodney, and a sanitarian of great repute, James Borland,[1] deputy to the Inspector General, and Dr. Lemprière, an army physician. They advised the evacuation of the island as the only remedy, and by the end of the year this had been gradually accomplished.

During the autumn the returning invalids had been sent to hospitals formed on the East Coast and run on both general and regimental lines. They were landed at Harwich, where the worst cases were admitted to a general hospital, the intermediate ones transported by boat to Ipswich, and the convalescents by wagons to Colchester. At the last place, Inspector W. R. Shrapter was in charge, and with him Sir James Fellowes, an army physician who had been knighted for his researches on fevers in S. Domingo. A number of temporary physicians were employed, among them Dr. Thomas Wright, who published a most learned pamphlet on the Walcheren

[1] James Borland joined as a surgeon's mate in 1792, at the age of 18, served two campaigns in Flanders and in the expedition to S. Domingo, 1796-98. He was at the Helder in 1799, after which, as D.I.G., he was in medical charge of the Russian troops quartered in the Channel Islands, and saw them through a severe typhus epidemic. He was offered and refused high rank in the Russian Medical Service. On the resumption of the war he was an Inspector of Hospitals at Headquarters in London, volunteered for Walcheren 1807, and was P.M.O. in the Mediterranean 1810-1816, when he was placed on half pay. He was made Honorary Physician to the Duke of Kent. Died 1863.

Fever. He thus described the barracks at Harwich which had been "humanely ordered by the Government to be converted into a hospital." "On a chearfull hill over Harwich has been constructed a barrack for infantry, etc., the soil forming a natural declivity by which the drains of rain water, of damp, and filth are provided for, should the artificial drains and sewers be obstructed. The houses or huts are of wood and disjunct, with wide intervening ways, every apartment opening to the street without communication with any other, every room ventilated through the ceiling so that the light non-respirable airs must be perpetually borne up while the heavier flow off below, at least during summer, so that if, with due attention to cleanliness and fumigation, contagion could not be obviated, yet the insulated state of each ward would prevent the progress of it." The barracks took 400 patients. In describing their appearance he writes: "The pallid looks of the breathing spectres was so ghastly, they exhibited a type of the resurrection, and their unhappy attendants, too few to administer relief to half the number through fatigue, were marked with melancholy little calculated to communicate hope or confidence in the sick." He mentions that, in the first convoy received, 20 bodies were sent ashore for burial, and 18 men died on their stretchers.

There were, later, hospitals at Deal, Portsmouth and Plymouth. In December the Surgeon General reported having inspected the various sick depots in Kent, where there were 4,000 patients, half in general and half in regimental hospitals. These included Ospringe Barracks and Preston House, near Faversham; the barracks at Ramsgate and Margate, and the Sea Bathing Establishment; Deal general and regimental hospitals; Dover Heights barracks; the Buckinghamshire Hospital, Dover; Shorncliffe Hospital; Hythe barracks and hospital; and the hospitals at Braeburn and Ashford. Beds to the number of 600 were handed over at Haslar. Mr. Keate commented unfavourably on the temporary mates and dispensers provided by his colleague, the Inspector General, many of whom, he stated, could barely write, spell, or read a prescription.

The following return, issued on February 1, 1810, gives the sick wastage of this campaign:—

	Officers	Other ranks
Embarked	1,738	37,481
Killed	7	99
Died..	40	2,041
Died at home..	29	1,859
Discharged	—	25
Remaining on the strength ..	1,671	33,373
Of which are reported sick ..	217	11,296

The prolonged sojourn of the troops in the unhealthy zone was the result of the hold up of the military operations. The popular idea at the time that Lord Chatham's procrastination and incompetence was the whole cause of the failure is not borne out by the evidence as judged by Sir John Fortescue. Lord Castlereagh has been justly blamed for his commitment of the Army without adequate consideration of the military problem in

consultation with expert advisers, and for his omission to consult the Medical Board on the probable sick wastage and possibility of lessening it. Had Antwerp been occupied by a *coup-de-main* as was anticipated, the sick list, though no doubt a heavy one, would have been justified by the result. The original provision made by the Surgeon General for the medical needs of a force proceeding to a destination unknown seems to have been a reasonable one. In the light of modern knowledge, it may be remarked that, whatever the transmitting agents, whether mosquitoes, lice, or contaminated water and food, the Army possessed its own reservoir of infection in the sickly drafts received from the survivors of Coruña.

The regular medical officers as a whole emerged with credit from the Walcheren campaign. Many of the temporary physicians who were sent out also showed great devotion in the performance of their work, but the temporary hospital mates were of poor quality. No one seems to have been much impressed by the conduct of the Medical Board, though they no doubt had to suffer much abuse for the sins of others. It was alleged that they failed to keep in touch with events at the front, and were only roused to action by public opinion, which was shocked at the aspect of the invalids sent home. Their squabbles among themselves were also a matter of notoriety. A report by the Commissioners of Military Inquiry dealing with the affairs of the Medical Department had been presented in 1808, in which various reforms were suggested. Possibly the demand for victims of some sort to expiate the Walcheren disaster brought matters to a head. At any rate, early in 1810, and with scant ceremony, Sir Lucas Pepys, Bart., President of the Royal College of Physicians, Thomas Keate, Master of the College of Surgeons, and Francis Knight, Inspector General, were informed that the Army no longer required their services, and the three, greatly protesting, were placed on half pay.

The appointment of Director General John Weir and two Principal Inspectors, which followed, was a definite epoch in the history of the Medical Service. The establishment of control by individuals, unhampered by private practice, and qualified from personal experience to appreciate the Army's peculiar needs, was a reform long overdue, though the break with the heads of the civil medical profession in London was a misfortune. Of recent years wise legislation and a combination of circumstances have done much to bring together the Army surgeon and his civilian brother. That the separation during the first half of the nineteenth century was no greater was largely due to the tact and professional eminence of the second Director General, Sir James McGrigor, who held that office from 1815 to 1851.

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THE AMERICAN WAR, 1812-1814.

BY LIEUTENANT-COLONEL G. A. KEMPTHORNE, D.S.O.,
Royal Army Medical Corps (R.P.).

WHEN, on April 14, 1814, the Peninsular War came to a happy conclusion, the country began to awake to the fact that something must be done about affairs on the North American Continent, where, for the past three years, a small British force had been engaged in defending Canada. The United States had declared war in June, 1812, over the question of the impressment of British seamen serving on board American ships. Canada was held by Sir George Prevost with four weak battalions of regular troops and as many militiamen. The contest was mainly round the Great Lakes, where, with varying fortunes, intermittent fighting had since been proceeding. Successes on land were countered by naval reverses on the lakes, and that the Dominion was saved was largely due to the mismanagement of the American Government and the incapacity of their commanders. The resources of the Medical Department in Canada were meagre. Deputy-Inspector Gabriel Redmond, who arrived as P.M.O. in October, 1812, reported all hospitals miserably bad, and medical and purveyor's stores deficient. There had been no replenishments since the War of Independence, which terminated thirty years before.[1]

In May, 1814, 2,400 troops sailed from the Garonne under command of General Ross. These, reinforced by another 1,000 from Bermuda, arrived off the American coast in August, and more were sent from home. Ross, supported by a naval squadron, landed his men on the banks of the Patuxent River, routed a force of militia at Bladensburg, and occupied Washington, where, in retaliation for the damage done by the enemy to Toronto the previous year, he burnt down the public buildings. The raid accomplished, the troops were re-embarked. It is evident that by this date the chief medical officer had begun to assume responsibility for the transporting of the sick and wounded. Sir Harry Smith, who was present as D.A.G., states that Alexander Baxter, the staff surgeon, brought away every wounded man fit to travel. Those left behind were confided to the care of some of the inhabitants, to whose credit it may be stated that they were well cared for. Half the army is reported to have been affected with dysentery.

An attempt on Baltimore followed, in which General Ross was killed. On September 11 our naval and military forces on Lake Champlain, advancing on Plattsburg, suffered a severe reverse. The American despatch stated that the army precipitately retreated, leaving the sick and wounded to their generosity.

In October more reinforcements arrived and were assembled at Halifax.

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[1] Extracts from Redmond's Journal were published in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xvii. He was invalided in June, 1813.

From the narrative of Captain J. H. Cooke of the 43rd we gain some impressions of the officer's life on a small transport. He embarked with a part of his regiment at Plymouth on the "Helen" brig, the cabin passengers including himself, Surgeon Matthew Heir of the 60th, Staff Surgeon Ryan, and eight other officers. "The small cabin contained two narrow berths on each side and two dark holes with doorways bearing the title of state cabins, from whence issued an effluvium which was a mixture of the most offensive and sickening compounds." Two officers were slung in cots under the skylight, and the remaining three were on the floor. Each paid £22 for pigs, poultry, sheep, porter, wine and fruit, but they never got a decent meal. Touching at Port Royal, the voyage occupied six weeks.

At the instance of the Admiral commanding on the station, the army was now launched against the town of New Orleans on the left bank of the Mississippi. General Pakenham, who was sent to command the troops, found them in contact with the enemy and involved in an impossible military situation. As the entrance of the river was barred, the ships came to anchor eighty-seven miles from the proposed landing place, which was at the head of Lake Borgne. A bare and desert island formed an intermediate post, from whence the men were transported by divisions through shoal water in small boats. On the island they were exposed, without shelter, to rain by day and frost by night, deprived even of their rations. The month was December.

Advancing through swamps, the enemy was found in a strong position covering the approach to the town. The British assault delivered on January 8 was repulsed with 2,000 casualties and the loss of the General. For nine days the British held their ground, while the majority of the wounded were laboriously conveyed to the shores of the lake, a distance of about nine miles. Some assistance was afforded by a small canal-cut, but the water was low and there were few boats. On the 18th a general retirement commenced; by the end of the month the remains of the force, sick, weary and dispirited, had been re-embarked. A few wounded, too ill to be moved, were left behind with a hospital mate.

The medical staff with the expedition appears to have been ample and to have done most creditable work. Referring to Deputy Inspector John Robb,[1] Sir Harry Smith says: "The number of wounded was three times what he was told to calculate for, but never did an officer meet the difficulties of his position with greater energy or display greater resources. I firmly assert not a wounded soldier was neglected." The medical work during the latter part of the American War reflects the high state of efficiency reached by the Department under McGrigor in the Peninsula. Peace had already been signed when this, the last engagement of the war, was being fought out.

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[1] John Robb served in the Peninsula. He became Brevet Inspector 1818, Inspector 1830. Died 1845.

ANCIENT CHEMICAL WARFARE.

BY CAPTAIN A. MAUDE,
Royal Army Medical Corps (Retired).

A CURIOUS passage in the fragments of Sextus Julius Africanus has been lately re-edited by M. Vieillefond. This historian, who wrote in Greek about A.D. 220, describing a cavalry action, says: "but the horses are easily turned to flight if some of the foot soldiers, denominated 'stripped,' behind the shield-bearing cavalry, are furnished with hand-syringes and the juice of the Euphorbia and eject this into the nostrils of the horses."

The word translated as hand-syringes is *χειροσίφωνα*, which occurs in several passages of the "Tactica" of Leo, being one of the forms of "flame-throwers" used for Greek fire. The word *χειροσίφωνα* had got corrupted in MSS. into *χείρεσι φωνά*, "noise with hands," and the passage thus became very obscure.

The original meaning of the Greek word syphon was simply a tube, but after the fifth century A.D. came to be applied to these apparatus of war. The illustrations of these weapons in Byzantine manuscripts are too small to give any information as to the propulsive power; in the case of the hand weapons it was probably a leathern bellows; but for the inflammable petroleum mixture known as Greek fire a metal piston must have been employed.

Thus far we are indebted to an excellent article by Mr. Roderick McKenzie of St. John's College, Oxford, in the *Classical Review*, February, 1933, which was followed in November by Professor Wentworth Thompson of St. Andrews on the Euphorbia. Many species of these plants secrete an acrid poisonous juice of highly irritating qualities. Its dried dust is described in Thorpe's Dictionary of Applied Chemistry as "causing violent and even dangerous irritation to the throat or nose." According to Professor Thompson, this variety of Euphorbia is *E. resinifera*. The properties of the plant were well known to the Romans; a book or pamphlet upon it was written by Juba II, the Prince of Mauritania whom Julius Cæsar carried as hostage to Rome in 46 B.C. to be the husband of Selene, the daughter of Cleopatra. The work of Juba has not survived, but extracts on the Euphorbia taken from it are preserved to us in Pliny's "Natural History," xxv, 38, in which he says, "Etiam levi gustu os accensum diu detineus et magis ex intervallo donec fauces quoque siccet." Its action as a sternutator has been compared by Professor Thompson to that of diphenyl-chloro-arsine recently employed.

It appears to me probable that its original use in war occurred with the Mauritanians, who were essentially cavalry soldiers, and had the plant ready to hand. Julius Africanus no doubt took his information from Juba's book. It is doubtful, however, if this sternutatory was ever widely employed, for no mention of its use is found in Vegetius' great treatise on military operations, compiled from previous writers about A.D. 400.

The history of these methods of warfare is interesting, largely because it is shrouded in secrecy, as its development is to-day.

BEYOND LEH.

A SHOOTING TRIP IN LADAKH, 1926.

Being a Diary kept by

K. W DICKSON, F.R.G.S.

(*Continued from p.* 466, *vol.* **lxi.**)

XVII.—Kaisser to Leh.

Next day we reached Kiarre, and the last night at Kaisser was the coldest we had since we were up the nullah. Even the near hills were covered with snow, and there was a sprinkling of snow on our tents. The same tiny white pony followed us. The snow melted very quickly, and the hills were a beautiful colour. By midday we were in lovely sunshine, almost too hot. We got to Kiarre in time for lunch, and sat down in a nook in the slate cliffs, but the heat from the reflection off the rocks was so great I had to sit by the river's edge to get the breeze, and yet we had snow that morning; Ladakh is really an extraordinary country!

Camp was pitched a few yards from the river, with boulders to keep the ropes down, as pegs were no use in the sand. Kiarre is a pretty spot, with a picturesque cantilever bridge. Here for the first time we saw trees in leaf. By the path, in crevices in the granite rock, wild roses grew; they were just coming into leaf. It was such a pleasure to see something green in that desert of weatherbeaten granite. I hoped we would soon see the roses in bloom. There were several duck on the river, and even a goose, but the larder was full, so the cartridges were saved for another time. We took a photograph, but wished it could have been in colour. Sand-martins were nesting in the cliffs just above the tents, and there were lots of swifts flying about.

We decided to go very early to bed as there was a big march before us next day, and all the worst parts of the road are between Kiarre and Kiamjun.

A great noise like thunder outside the tent, and R. rushed out to see what it was. An obstreperous yak had been tied to a large log of wood on the sand, and the big beast was dragging the log along with it. The Ladakhi pony men were in fits of laughter; they have any amount of humour, and are the first to see a joke, even against themselves. All along our route we found them so helpful and willing, and neither grasping nor greedy.

We were right in anticipating a long tiring march. We were so weary when we got to the foot of the Kiamjun nullah, we felt inclined to turn into bed without waiting for dinner. It was a perfect day so far as weather

was concerned, and the hills looked so very different in the sunshine; almost any country looks depressing when the sun is hidden behind clouds, but in a land where vegetation is almost absent, it is more noticeable.

The marches were much cheerier than they had been a fortnight before when we were getting to a colder and even more desolate wilderness. Knowing it was going to be a trying march, I rode whenever it was possible, which was not very often, and the pony was old and slow. R. had to sit and wait for five minutes every quarter of a mile.

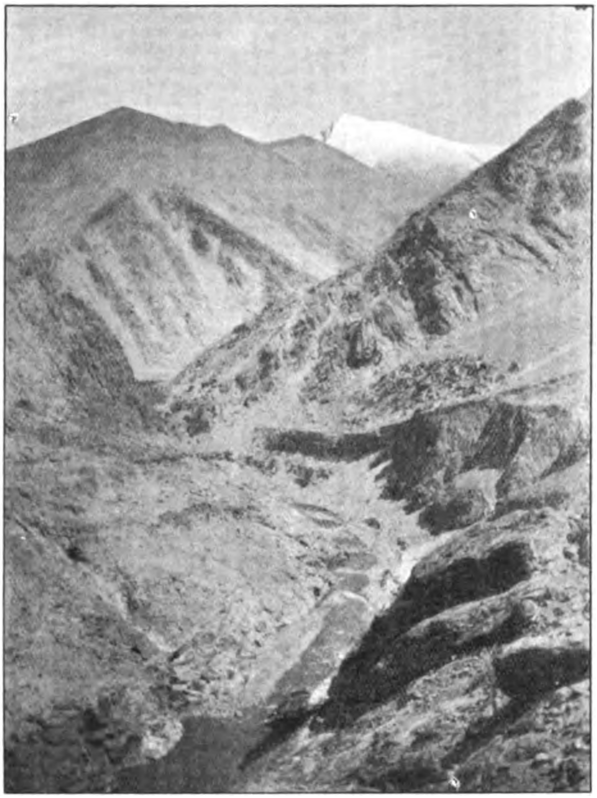

FIG. 19.—Path high above the Indus near Kiamjun.

I was delighted to find that instead of approaching a precipice with dread, I found the climb before Gaik really exhilarating. After following a path not more than 20 feet above a river bed, it was a pleasant change to mount up on the cliffs and look down on the blue green river, hundreds of feet in the gorge below.

I spied two or three burrhel on the opposite bank of the river, and as we came down the path the dogs saw them, and giving tongue sent them flying up the face of the cliffs. We got out the glasses and watched them.

It was a large herd of twenty-two. It was satisfactory to note that there was no head of any size among them.

Gaik is only a little circle of fields at the end of a deep ravine. The path to the top of the cliff is almost like a staircase; it is so steep and is also covered with boulders, which made it difficult going for the animals.

On coming round the top of the cliffs we started another herd of burrhel. They had been drinking at the river and were on their way back. The dogs were off before we could stop them, up the side of the hill, leaping

FIG. 20.—On the rocky path near Gaik.

from rock to rock. It gave us an exhibition of how burrhel could leap up the face of a cliff. Garry came back to us when the chase was over, but I missed Kelpie. The transport passed, but no sign of him. Jit Ram said he had seen him miles back chasing burrhel among the rocks; most unlike our quiet Kelpie, but he renewed his youth on this trek. He had been very sick early in March and we were afraid he would not be fit for long marches. We watched him in the snow in case an extra coolie might be wanted to carry him. There was no possible place to leave him *en route*

until we reached Leh, but he gained strength daily. It was grand to see his tucked-up movements in the snow gradually change into a fine free action as he raced along with Garry. I had to send a man back to look for him, and he turned up while we were having tiffin, not very sure of his reception, and he lay in a pool of water panting hard until we finished.

For the next two hours the path wound up and down those long staircases. It was weary going, as even when it was somewhat level it was so rough that a pony was of little use, and walking, one could never get into a stride. We lay on a grassy bank on an island in the river opposite Tirido, and watched the people ploughing. I can still hear the monotonous but cheery chant as they worked. Here even the willows were in leaf, a delightful fresh green.

Camp was pitched on our old ground before we arrived. I spent the evening mending socks as I found we had by no means too many spare pairs. These rough roads rubbed the heels out of anything, and we always wore two pairs under the leather chapplie boot.

We were in Likshi the following day. It was the prettiest camping ground we had struck so far. All the tiny fields were now green. The poplars and willows were both in leaf, and our tents were just above the river in a small willow grove. I never knew before that willow trees had any smell; the flowers of these had a delightful fresh scent. I was longing for the smell of flowers and for lettuce to eat, and here was this satisfying smell.

With these early starts we often go for miles before the sun reaches us as the hills to the east are so high, but that morning we got into sunshine almost at once, although the granite cliffs rose up nearly vertically from the river. The granite was a beautiful golden russet in the light of the morning sun; many tones lighter than the deep blue of the sky.

We rested under a rock before crossing the bridge at Yiamia. Even Garry was glad to give up his hunting and get into shade for a short time. The difference in the vegetation in a fortnight was extraordinary. The villages seemed transformed, and were noticeable now from a long way off. Women were working in the fields, walking about with bare feet, directing the flow of the irrigation water. They have tiny little feet like Chinese ladies.

Great masses of granite towered up on our right, R. said nearly a thousand feet high. The old path had been built up on the north side of the river, but it had been washed away in floods, so bridges had to be built, and the path went on the other side. The people told us these bridges have to be renewed yearly. The longest bridge we had seen was the one between Yiamia and Likshi. Here we rested, as we thought the yaks crossing would make a good photograph. The transport was slow that day and we had to wait for some time. The sky had been cloudless, but clouds were blowing up, and there was not a ray of sunshine when the yaks were actually crossing. It was most disappointing; "damnable" R. called

it! and we had saved a roll of films specially. He took a time exposure, but I was afraid it would not come out well. The river itself looked so different in sunshine, and shadows were needed to show up the rocks.

Khazir But told me that a Ladakhi man had dropped an axe in the river when crossing. I was rather incredulous, and afterwards if anything went missing, I asked him if it had been dropped in the river.

We crossed the river and went on for a mile or two, making the halt for the midday meal on a little sandy beach where there were rocks to lean against. We saw Garry sniffing and sniffing towards the river, and sure enough, between some scrubby bushes, feeding on some turf, were burrhel. Garry's yapping soon sent them up the hill, but they did not go far, and we watched them at intervals during lunch. They lay about on the most precipitous looking rocks chewing the cud. I could see their little mouths moving. Their black tails on a white background show up when they move. They were only 200 yards away, but it was really difficult to see them against the rock, so protective was their colouring.

Tea in camp; then I cut R.'s hair with the clippers (Bill's gift to Kelpie, but they had been sterilized). I am not an accomplished barber, but I flatter myself the result is as good as the barber's, although I take some time over it.

Khansamah delighted to surprise us with excellent meals. That night we had hare soup, roast saddle of burrhel, and a chocolate cream pudding made with strained oatmeal instead of gelatine. Who could have wished for a better dinner, when the best of sauces was not wanting!

On the first of June we reached Sherra. It was a joy to be alive and tramping along that morning at half past six. The granite cliffs were golden in the morning light, and the Indus had all the colours of the rainbow. One didn't want to ride on such a morning, and I walked as far as the second bridge; the path crosses and recrosses the river here. We had our usual 10 minutes halt after 50 minutes walking, and were sitting about fifty yards above the bridge. I heard shouts from below and thought it was a goat-herd by the waterside, but when we got down we found that my pony had fallen on the bridge. In Ladakh if there is a hole in a bridge, instead of mending it, a large stone is placed over the hole so that an animal avoids it. The pony's foot had slipped and gone under one of the stones. With sticks and the help of four men, the stone was raised at last and the pony freed, and it crossed the bridge shivering with fright, evidently hating the rushing water below. Then Garry bounded over, knocking down several great boulders and a spar into the water. The shikari said the bridge was made only a week or two before we crossed on our outward journey. It seemed a nervous pony, and I kept my knees glued to the saddle for the first half hour after I got on to it.

It was a short march and we reached Sherra by 10 o'clock, had a cup of coffee, then sat feasting our eyes on the green fields and tiny poplar groves after seven miles of rocks and sand. The glare from crumbled

granite is almost like the snow glare in strong sunshine. We passed many lines of Mani walls that day. We think they must have become sacred through their usefulness in clearing the pasture land from stones, and so gradually became universal. There must be enough granite in Ladakh to build all the cities in the world, and enough slate to roof the houses.

At Likshi an old man and a boy came to the camp begging for money or food. He looked such a respectable old person I gave him an anna, and he bowed and gave me his prayer wheel to turn. It was a fine old one, made of copper and brass. Another day we met a lama riding a small pony, and driving a flock of sheep in front of him. Each sheep had a little woollen saddle bag on its back like a miniature camel bag. The bags were filled with salt and grain. To my surprise they did not seem to be tied on in any way.

R. took out the gun and got a chikor and a fine big hare straight away. We wanted to take some game to the Padre and his wife in Leh. They live on mutton all the year round as no bullock can be killed in a Hindu state, and the Padre himself had no gun.

We had a nice camping ground beside a stream well beyond the village.

R.'s knees were badly burnt that day with the sun, that being the first time he had worn shorts. He had probably got a touch of the sun from the glare of the granite, as he got quite faint at dinner. I went to the medicine chest for brandy or sal volatile, only to find there was not a drop of either; there were no liquids left in any of the bottles. It was rather disturbing to find there was no brandy when R. was so faint, but I knew I had two tiny bottles of sherry and rum for flavouring tucked away somewhere, so I gave R. the sherry, and kept the rum beside us all night.

We had a good rest by the wayside next day. R. was very much better; he slept well, and we had early tea at the usual time. I was very sleepy as I had not had much sleep for two nights. I got a chill the night we spent at Likshi—still, fresh air was the best thing for want of sleep.

There were many interests on the road. We were coming to sharpu country now, and there was a herd feeding on the other side of the river beyond Upshi. Sharpu are much lighter in colour than burrhel, and are lighter in build too, and the horns are quite different.

The path to Simla which started at Upshi looked inviting. I would have liked to have gone to Kasauli that way instead of going back to Srinagar, but it was not to be thought of; our car waited for us in Kashmir, and in any case Mr. Kunick told me that the passes by that route would not be open until well into July.

A few hundred yards before we reached Ugu, R. and I were both riding along the path on the lower side of a Mani wall. I looked up and suddenly saw a beautiful grey fox stealing up the rocks on our right. Its back was almost black, with white tips, and the under part of its body was light buff coloured. It had a most beautiful bushy tail. I shouted to R., but by the time he had dismounted, and the shikari had got the rifle out of its cloth

case, the fox was well up the hill. R. had a flying shot at it from our side of the Mani wall, but he had no time to get the telescope sight adjusted. I was holding the dogs but Kelpie slipped his collar and joined in the chase. R. had another shot which splintered the rock between the legs of the fox, but it got away. It was very disappointing as even the shikari was very excited; it was such a beautiful specimen. He said he had not seen one like it for many years. R. went up the hill before supper to see if by any chance the fox had been wounded and was still lurking near, but there were no traces of it. I expect it was ten miles away by that time.

Burra Subhana came back from Leh that evening with our mail, and we spent the evening reading it.

Next day we were Cook's tourists, sight-seeing, and a tiring day it turned out to be, although it had many interests.

We had left the granite cliffs now. The range on the south of the river was a gentle slope compared with the cliff country we had passed through. The strata were in horizontal layers, becoming more and more vertical as we got nearer Leh.

We set out to see Haemis monastery where the famous festival is held every year. To see Haemis we crossed the river at Marselong, going about four miles out of our way. On the other side a well-worn track went up and up over a long rise until we reached an enormous Mani wall twenty feet broad, and five or six hundred yards long. The tiffin coolies were loth to go any further so we left them there but took the pony. The path wound for a mile at least by the side of a stream; the far side was terraced and cultivated, but our side was rocks with occasional mud huts perched on the rocks. After going under a large chorten we turned to the right round a high shoulder of rock and came to the village, and soon the monastery itself came in sight. Both the village and the monastery are completely hidden from the valley below. The rocky ravine in which they lie looks just like any other uninhabited cleft in the hills. The monastery seemed very like most of the others we had seen, but larger, with a fine courtyard, and great plumes of yak's hair crowning the roof like the plumes of an old hearse. There appeared to be no lama of any standing about, only carpenters busy building a new right wing, and crowds of dirty children. A young lama, whose appearance I did not like, came and stared at us. In a far porch another lama was painting the wheel of life in brilliant colours. He was a skilled artist and the result was very decorative. The roof of the porch was made of clean willow branches painted a bright grass green, while the great beams were a crude blue. All the walls inside were illuminated with goddesses, devils and dragons. A big Chinese type of dragon just looked as if it had walked off a piece of old china. I think we were unfortunate in not meeting a lama who understood Urdu, as probably we should have seen some of the enormous idols inside, and I would have liked to see the kitchens of the monastery. I had heard about the great copper boilers, and the fireplace where whole sheep could be

roasted, many at a time. We took a photograph of the courtyard, and one of the whole building before leaving.

A short rest where we had left the coolies, and then on our way again over a veritable desert of rubble, stones and sand. This route was higher, and we had a much more extensive view of the Leh hills and those behind. I rode for two hours, and then R. had a turn on the pony. I thought the camping ground must soon be in sight as we neared a village. Suddenly I saw two tents, and as we were very weary, I was indeed thankful, but in

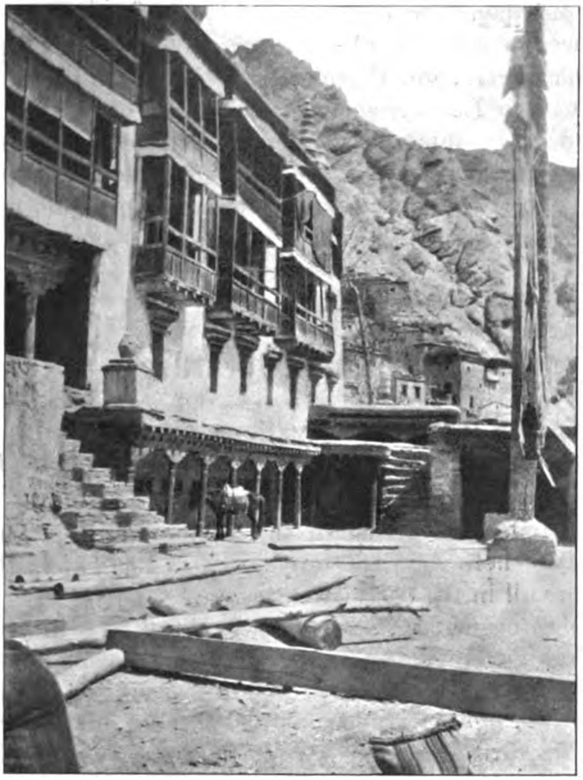

FIG. 21.—Haemis monastery. The courtyard.

another minute I saw they were tattered and torn, and nothing like ours, just a Tibetan gipsy encampment. We came to clumps of tiny irises, very much smaller than those that grow in Kashmir. Mrs. Kunick says flowers are all small in Ladakh because of the altitude. We wandered on and on, through a village, and by canals bigger than any we had seen, one at least eighteen feet wide. The pony man made me dismount, although I felt I would be much safer fording the stream on the pony's back than walking across the bridge, which was a single trunk of poplar, flat on the top, about six inches wide. Crossing it was a feat of balancing. Garry crossed, but

nothing would persuade Kelpie to cross it. He tried several times, but always turned back, then galloped along the bank barking loudly, afraid we would leave him behind. At last, after a lot of coaxing, he came through the water, and we pulled him up the further bank, dripping wet, but very proud of himself.

After another half hour by canal banks we met Khazir But on a pony He had come out to look for us as he thought we were overdue, I suppose He got a good scolding for pitching the camp so far away, and was told that a 22-mile march and seeing over a monastery were too much for the Mem-sahib in one day.

The camp was in a delightful willow grove, the Golab Bagh, at Shushot. Water was everywhere, and there was no dust. If we had not been so anxious to return to Leh on account of sharpu, we would certainly have waited a few days in this spot. We watched the sun set over the dim purple hills, and saw it rise over the snows to the east next morning. I thought it was one of the most beautiful camping grounds I had ever seen.

(*To be continued.*)

Current Literature.

BRANSON, WILLIAM P. S. **Observations on the Health of a Nursing Staff.** St. Bartholomew's Hospital Reports. 1933. lxvi, 125.

These observations have been made on the health of the nurses serving their four years indenture period in the hospital during the years 1922 to 1931. Until 1930 there were 260 nurses, 300 in 1930, and 340 at the end of 1931; they were all in the early twenties.

Most sickness occurred in January to April, the maximum being in February when an average of about 8 per cent were off duty. From June to October the number off duty was about 4 per cent. The writer lays down the following figures which may be expected in the various months—from January to April from 6 per cent in a good year to 9 per cent in a bad year; in May, November and December from 5 to 7 per cent; from June to October from 4 to 5 per cent. During an influenza outbreak in 1922 no fewer than 18 per cent of the nurses were off duty.

A striking table gives the number of attacks of illness each year.

	Average number at risk	Attacks of illness	
1922	255	345	Total in first hemi-decade—1,551
1923	255	300	
1924	255	331	
1925	254	324	
1926	254	251	
1927	261	314	Total in second hemi-decade—1,444
1928	259	264	
1929	261	301	
1930	300	252	
1931	340	313	

In an analysis of illnesses during the various years of service it was found that nurses in their first year provided almost as many attacks of illness as all the nurses of the second, third and fourth year periods.

The ailments have been divided into two groups A and B. Group A comprises "sepsis," catarrhal diseases such as colds and influenza, and sore throat, exclusive of diphtheria and scarlet fever. Septic fingers provided the majority of the septic cases, and during the years 1922-6 the period off duty for this cause exceeded twenty-eight days in from 8 to 16 per cent of the cases. Pricks from safety pins were the cause of a good number of the septic fingers.

Sore throat was especially common among first year nurses.

	1922-26	1927-31
Attacks of sepsis	356	315
Attacks of catarrhal diseases ..	314	312
Attacks of sore throat	262	228
Group A Total	932	855

Group B is a group of varied disorders to most of which nurses are not especially prone, but it includes the infectious diseases, and diphtheria and scarlet fever are remarked on.

Schick testing and immunizing of positive reactors have been in force among all new entrants since 1929, since when there have been only three cases of diphtheria, but the writer considers the experience too recent for dogmatic statement.

From 1922-26 the average number of days lost annually from scarlet fever was 214, and between 1922 and 1931 the lowest number of cases in a year was one and the highest eight.

	1922-26	1927-31
Group B Total	619	589

The improvement in health during the last five years is attributed to better housing of the nurses, lessening of the hours on duty, and improvement in diet. An apple a day, or its equivalent in other fruit, has been given to each nurse since 1928, and it is surprising to see that in 1931 the cost of this small addition to the diet was £463.

Statutory Rules and Orders, 1933, No. 38. **Public Health, England. Prevention of Infectious and Epidemic Diseases. The Port Sanitary Regulations, 1933, dated February 4, 1933.** 25 pp. 1933. London: H.M.S.O. [7d.]

Ministry of Health. **Circular 1296. Port Sanitary Regulations, 1933.** 8 pp. 1933. February 13.

These new Regulations came into operation on May 1, 1933, and are designed to consolidate in one code the whole of the regulations relating to the control of conditions liable to lead to the spread of infectious disease

from or to ships in ports in England and Wales. They revoke the Regulations issued in 1907, relating to cholera, yellow fever and plague in ships from foreign ports, coastwise ships and outward bound ships, and also the Port Sanitary Authorities (Infectious Diseases) Regulations, 1920, and the Public Health (Deratisation of Ships) Regulations, 1929. The definitions of the terms "infected ship" and "suspected ship" in relation to cholera, plague and yellow fever respectively are amended in accordance with the International Sanitary Convention, 1926, and the sanitary measures prescribed in regard to such ships, and also to any in which typhus fever or smallpox has occurred, are precisely as laid down in the International Sanitary Convention. The Port Sanitary Authorities (Infectious Diseases) Regulations, 1926, and the Public Health (Deratisation of Ships) Regulations, 1929, appear practically unaltered as part of the new Regulations. There are, however, a number of new and important provisions. In the first place, the Master of a foreign-going ship approaching a port in England or Wales is required to ascertain the state of health of all persons on board and to fill in and sign a Declaration of Health in the prescribed form. [Thus, the Master will not, in future, be able to plead as an excuse for failure to notify sickness that he was not aware of any case of illness aboard his ship. It will be his duty to ascertain whether all are in good health and, if not, to notify the Port Sanitary Authority, unless he is satisfied that no question of infection or the spread of infectious disease is involved.] The Declaration of Health sets out the symptoms which should lead a Master to suspect that a case of illness is one of the notifiable infectious diseases.

The definition of a "foreign-going ship" does not include ships trading between ports in Great Britain and ports on the continent of Europe between the River Elbe and Brest. The Masters of such ships are thus exempted from the above requirements.

[It is obvious that the Masters of packet-boats to and from the Continent could not comply, but there does not seem to be any sufficient reason for extending this concession to cargo vessels.]

The Regulations provide that, in ports where there are arrangements for the reception by the Port Sanitary Authority of wireless messages, the Minister is prepared to publish in the *London Gazette* a notice that ships which are equipped with wireless transmitting apparatus and which require the attention of the Port Medical Officer shall send to the Port Sanitary Authority, not more than twelve and not less than four hours before the expected time of arrival of the ship, a wireless message giving the necessary information.

New instructions are issued in regard to the "Flags and Signal Lights" to be shown by ships as indications of the health conditions on board. The Port Sanitary Authority is required to establish, with the concurrence of the Customs Officer and the Harbour Master, one or more "mooring stations" within the docks where ships can, if necessary, be isolated.

Similarly, a mooring station outside the docks must be established, if local conditions permit. "Infected" or "suspected" ships must be taken to a mooring station, unless the Medical Officer of Health otherwise directs.

The Medical Officer of Health must prepare and keep up to date a list of ports which are infected or suspected to be infected with plague (human or rodent), cholera, yellow fever, typhus or smallpox, and must supply pilots and Customs officers with such list and any amendments therefore.

As formerly, pratique, i.e., permission for a ship to have free communication with the shore, can only be granted by an officer of H.M. Customs. A Customs officer on boarding a ship must, therefore, peruse the Declaration of Health and may make any further enquiries. If, in consequence, he is of the opinion that the health conditions of the ship require investigation by the Port Medical Officer, or if the ship has sailed from or called at any port on the list of infected ports or is for any other reason subject to the special instructions of the Medical Officer of Health, the Customs Officer must detain such ship until it has been medically inspected, and such inspections must be carried out within twelve hours. If the Port Medical Officer boards a ship before the Customs Officer, he may take such steps as are indicated by the health conditions on board, and notify the Customs Officer when there are no medical reasons for withholding pratique. No person other than the pilot, Customs Officer, Immigration Officer, or officer of the Port Sanitary Authority may board or leave a ship without the permission of the Medical Officer of Health until it is free from control under these Regulations.

The Medical Officer may make the granting of such permission conditional upon the person concerned giving his name, intended destination and address and any other information reasonably required for the purpose of these Regulations.

If plague (human or rodent), cholera, yellow fever, typhus or smallpox, occurs on board a ship after it has arrived in the port, the Medical Officer of Health may, if he thinks fit, order the removal of the ship to a mooring station.

The Medical Officer of Health is empowered to board any ship, examine any person who is suffering from or may have been exposed to infectious disease, or who is believed to be verminous, and may order such isolation of persons on board or ashore and such measures of disinfection as he deems necessary. The Master of a ship is required to notify the occurrence of infectious disease on board, to answer all health questions and to render such assistance as may be reasonably required.

The Medical Officer of Health may examine any person proposing to embark on a ship whom he suspects to be suffering from plague, cholera, yellow fever, typhus or smallpox, and prohibit his embarkation if necessary. He may also prohibit the embarkation of persons who are contacts with the severe type of smallpox or who have come from a district where this disease exists. If the Minister of Health has declared a district in

England or Wales to be infected with the diseases named above the Medical Officer of Health of the port concerned has certain other obligations for the protection of ships within such port.

Where, under these Regulations, the Master of a ship is required to carry out measures for the prevention of the spread of infection the Port Sanitary Authority may, at the request of the Master and if they think fit at his cost, carry out such measures on his behalf, but if any charges are so made they must not exceed the cost incurred by the Authority, and must not in any case exceed £20 unless notice of the charge has been given to the Master before the commencement of the work.

[These Regulations will certainly be welcomed by all Port Sanitary Authorities, for they will bring quarantine administration in this country up to date, and should make it as nearly uniform as is practicable in the ports of the United Kingdom.]

CHAS. F. WHITE.

Reprinted from "Bulletin of Hygiene," Vol. 8, No. 11.

HOME OFFICE. **Ventilation of Factories and Workshops. Second Edition.** Welfare Pamphlet, No. 5. 51 pp., 53 figs. 1933. London: H.M.S.O. [1s.].

This publication comprises a constructive account of present-day factory ventilation in theory and practice.

The requirements of the British Factory and Workshop Act do not tie manufacturers to strict "codes" to which the physical conditions of air must be made to conform; it is recognized that the science of ventilation is as yet incomplete, and the factory owner has much latitude in the choice of methods and apparatus to provide sufficient ventilation and to maintain a reasonable temperature.

The five chief physical factors of ventilation are described—temperature, humidity, cooling power, diversity of temperature and temperature gradient, radiation—to cold surfaces or from heated surfaces.

Standards.

The superseding of old standards of air purity, based on percentages of CO_2 is discussed and present-day standards are presented, though in a tentative manner. Minimal values for these standards may be quoted:—

Air Changes.—6 per hour.

Natural Ventilation.—Five square feet of window per 100 square feet of floor.

Speed of Entry of Air to Rooms.—Not greater than 250 feet per minute.

Cooling Power—Dry Katathermometer.—A minimum of 6 millicalories per square centimetre per second is regarded as desirable for rooms where sedentary or light work is carried on at normal room temperature. (Since

this standard was presented by Leonard Hill, Vernon has put forward 5 for summer and 7 for winter as seasonable figures.)

Humidity.—The significance of the wet bulb reading in hot factories. Cotton Cloth Factories Regulations, 1929, prohibit all artificial humidification when the wet bulb temperature exceeds 72½° F.

Natural Ventilation.

Windows suitable for factories, Tobin tubes, roof openings and roof ventilators are described and well illustrated, with photographs of actual installations. It is pointed out that exaggerated views are sometimes held as to the value of small ventilators, which are often much too small in relation to the spaces to be ventilated.

Mechanical Ventilation.

The characteristics of propeller or disc fans are described. These useful fans are frequently put to work under unfavourable circumstances with resulting waste of power and lost effect, and the pages dealing with their limitations may be well studied by works' managers or engineers who are unfamiliar with the essential properties of these fans, and the total inability of such fans to work against considerable static pressures. Centrifugal fans are also described and illustrated and the characteristic volume-static pressure curves for typical designs are given. Mechanical devices for creating desirable air movement are described ; namely, portable " Orbit " Fans, Overhead (suspended) Air Circulating Fans, and Jet Fans—for cooling the occupants of offices, restaurants and large factory buildings.

Mechanical Ventilation Systems.

Air extraction systems are dealt with and illustrated and the need for arranging that the accompanying air inlets are properly placed and of sufficient capacity is pointed out. Plenum systems are also described and the need for properly designed duct work explained. Two pages are devoted to Heating, but the announcement is made that a new publication on Industrial Heating is in course of preparation.

Instruments and Apparatus for Ascertaining Atmospheric Air Conditions.

Notes are given on the Wet and Dry Bulb Thermometer, the Katathermometer and the Haldane apparatus for measuring the carbon dioxide concentration, with instructions and references. Readers are referred to E. Ower's book, " Measurements of Air Flow," for information as to the anemometer, the Pitot tube, and other instruments needed to measure air quantities and to determine the performances of fans.

T. C. ANGUS.

Reprinted from " Bulletin of Hygiene," Vol. 8, *No.* 11.

KON, PHYLLIS M. **Coliform Organisms in Milk and Bovine Fæces.** *J. Dairy Res.* 1933, v. 4, 206-12. [15 refs.]

To differentiate the coliform organisms reliance was placed upon the methyl red, indol, Voges-Proskauer, and citric acid fermentation tests, while gelatin liquefaction was also used to distinguish *Bacillus cloacae.* With cultures from milk in the first examination as many as thirty out of fifty-five colonies were indefinite, in that with these tests they did not fall clearly into one or other of the named types. Further testing showed that this was due in all but six cases to mixtures of two organisms. The final groupings yielded *B. coli* 58, *B. aerogenes* 42, *B. cloacae* 4, intermediate 6—total 110. When cultures were made directly from milk without preliminary enrichment in lactose bile salt medium the proportion of *B. aerogenes* to *B. coli* was very much higher. With cow dung, on the other hand, out of 47 colonies 44 were fæcal *B. coli,* 1 was *B. aerogenes* and 2 liquefied gelatin. These facts suggest that many of the coliform types found in milk are derived, not from fæces, in which the proportion of *aerogenes* is small, but from external sources, such as contaminated utensils and from foodstuffs.

W. G. SAVAGE.

Reprinted from "Bulletin of Hygiene," Vol. 8, *No.* 11.

Reviews.

BLOOD PICTURES: AN INTRODUCTION TO CLINICAL HÆMATOLOGY. Third Edition. By Cecil Price-Jones, M.B.Lond. Bristol: John Wright and Sons, Ltd. 1933. Pp. 72. Price 6s. 6d.

The third edition of this most useful little book fully attains the author's objective, viz., to provide some guide to the interpretation of laboratory reports and to enable practitioners themselves to carry out blood examinations. The book is divided into two parts with a total of nine clearly and concisely written chapters.

Part I deals with the technique of blood examinations, a description of the blood cells and the normal blood-picture. For cell counts, the author recommends a hæmocytometer with the Bürker ruling. The method of counting and the calculations resulting are lucidly explained. The enumeration of platelets and a satisfactory peroxidase test are also included in this part.

Part II is concerned with blood-pictures in the diagnosis of disease. The pictures are presented in tabular form, and against each item in any one picture is stated the count, and in addition, a symbol indicating whether the count is above, below or within normal limits. A method for the measurement of the size of red blood cells is also included.

It is an excellent book and can be confidently recommended. It would

make a valuable addition to the clinical side-room book shelf of any hospital, but especially to hospitals abroad. With it for reference and guide, the medical officer could have confidence in the results of his blood examinations and would be greatly assisted in drawing the correct conclusions therefrom. H. T. F.

STUDIES FROM THE INSTITUTE FOR MEDICAL RESEARCH, FEDERATED MALAY STATES, No. 21, MELIOIDOSIS. By A. T. Stanton, C.M.G., M.D., F.R.C.P., and William Fletcher, M.D., M.R.C.P. London: John Bale, Sons and Danielsson, Ltd. 1932. Pp. v + 60, with 37 illustrations.

This monograph presents a fairly detailed account of melioidosis and of the causative organism *B. whitmori*. The descriptions have special reference to the disease as it occurs in Malaya. Most of the subject matter has already appeared in various journals, but it is convenient to have the work in one binding augmented by a series of excellent photographs illustrating the pathology and bacteriology of the disease.

RESEARCHES PUBLISHED FROM THE WARDS AND LABORATORIES OF THE LONDON HOSPITAL, 1932. London: H. K. Lewis and Co., Ltd. Price 7s. 6d.

The present volume consists of a collection of papers already published in such journals as the *Lancet, Quarterly Journal of Medicine, Proceedings of the Royal Society*, etc.

The ground covered includes some very important work in recent medical research, and it is most convenient to have this series of papers in one volume for reference. Of the more important contributions to medical advance we may briefly refer to Levy Simpson's paper on Addison's disease and the rôle which suprarenal cortical extract may play in its future treatment. Idiopathic steatorrhœa is dealt with by Bennett, Hunter and Vaughan in an exhaustive monograph in which detailed clinical and bio-chemical findings of fifteen cases of this disease are fully described.

The volume contains many other papers based on original observation and research and will be found to be a necessity to every up-to-date medical library. It seems rather a pity that such valuable papers could not all be reprinted in the quarto size of the *Quarterly Journal of Medicine* so as to facilitate binding in permanent form. J. H.-S.

A TREATISE ON MATERIA MEDICA AND THERAPEUTICS. By Birendra Nath Ghosh, F.R.F.P. & S.(Glas). Calcutta: Hilton and Co. 1933. London Agents: H. K. Lewis and Co., Ltd. Pp. xv + 712. Price Rs. 7.8 or 12s. 6d.

The thirteenth edition of this publication is to hand, and will be found up-to-date and a thoroughly useful work of reference for the dispenser abroad.

There is appended a short section dealing with Indian indigenous

drugs—a condensation of the most useful information from the author's larger book on the same subject.

We have no fault to find with the pharmacology section of this well-known book, but it follows the lines of equally well-known standard works on the same subject, and so it is hardly likely to meet with a great demand in this country.

As regards the therapeutics section, it would really be better if some of these entirely inadequate smatterings were omitted altogether (we do not confine the criticism to the book here reviewed).

The whole subject of organotherapy is here compressed into seven pages, while that of the use and application of radium occupies just four and one-third. Comment is needless, for no one is likely to rely upon such condensed information as is possible in such a small space.

We repeat such books as these would be better, smaller, more useful and incidentally cheaper, if their subject matter was limited to what they profess to deal with. There are plenty of larger works for the study of special therapeutic measures. J. H.-S.

NOTES ON SANITATION FOR INDIAN TROOPS. By Captain T. F. Paterson, B.A., M.B., I.M.S. Re-edited by Major D. R. Thapar, M.D., D.T.M. and H., I.M.S. With a translation in Urdu by Sub-Assistant Surgeon Jemadar Basant Singh, I.M.D. Calcutta: Lal Chaud and Sons. 1933. Rupee 1.

The re-publication of Captain (now Major-General) T. F. Paterson's "Notes on Sanitation for Indian Troops" should bring forth a sigh of relief and a pæan of praise from all officers in medical charge of effective troops.

This little manual has been re-edited by Major D. R. Thapar, who has done the work in an able and conscientious manner. The information contained in the manual is simply put, sufficiently comprehensive and thoroughly up to date. How long it will retain the latter quality is another matter for, nowadays, medicine—like motoring and morals—moves with a speed and changes with a rapidity which Major-General Paterson could not have foreseen when he was serving with the 37th Lancers.

Already tablets of ammonia and chlorine threaten to displace tinned bleach; and they, in turn, threaten to render obsolete the famous "Horrocks' Box." Plasmoquine (of which there is no mention in the book) has come to stay, and typhus is unfolding certain new and surprising aspects. A short note regarding typhus might well have been included in Chapter XII—where, by the way, we dislike the term "Malta fever." We also dislike "filteration"; but at least we are spared "laterine."

The vernacular companion has been admirably dealt with by Jemadar Basant Singh. The translation is marked by clarity and simplicity; and those who—like the reviewer—have but a weak and limited knowledge of Urdu will be the first to congratulate the Jemadar sahib on the successful outcome of his task.

Inevitably, the book challenges comparison with that popular publication, "Life, Light and Cleanliness," by Colonel E. L. Perry, and now, alas! quite out of date. It was a delightful little treatise, with a human and special appeal to the Indian. It is certain that, if a book similar to this, but adapted for military use, were put on the market, it would prove a serious rival to "Notes on Sanitation for Indian Troops." But an author of the calibre and imagination of Colonel Perry is not born every day; and the "Notes," even if somewhat flavoured with dry officialdom, at least contain lots of good, easily digested meat; they instruct, even if they neither amuse nor inspire.

We echo the sentiments expressed in the Foreword by Major-General W. H. S. Nickerson, V.C., and wish this latest publication a useful, health-giving voyage.

AN INDEX OF TREATMENT. By various writers. Edited by Robert Hutchinson, M.D., F.R.C.P. Bristol: John Wright and Sons. Pp. xviii + 1027. 42s. net.

The tenth edition of this now famous therapeutic index appears in a similar form to its predecessors, but is enlarged by the addition of several new articles. Such a work does not lend itself to detailed review, but among a host of valuable features we might draw especial attention to such really useful sections as those dealing with anæsthesia in children or the various conditions under which electrotherapy may be of value. It is not easy for the busy man to search for such information unless he has ready access to a large library.

In this volume the information required on these and many kindred subjects is ready to hand, concise and sifted from unimportant non-essentials. The book tells the practitioner exactly what he wants to know with a minimum expenditure of time and trouble, and in this respect amply fulfils the essentials of an index. Perhaps one of its best features is the manner in which the different techniques of minor surgical procedures are expressed with a clarity and exactitude that leaves nothing to be desired.

We can thoroughly recommend this volume to all libraries and practitioners.

J. H.-S.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

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No. 3. March, 1934. Vol. LXII.

Journal OF THE Royal Army Medical Corps

ISSUED MONTHLY

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VOL. LXII. MARCH, 1934. No. 3.

Journal of the Royal Army Medical Corps.

Original Communications.

ANTITYPHOID INOCULATION.

Observations on the Immunizing Properties and on the Manufacture of Typhoid Vaccine.

BY BREVET COLONEL H. MARRIAN PERRY, O.B.E., K.H.S.,
MAJOR H. T. FINDLAY,
AND
MAJOR H. J. BENSTED, M.C.
Royal Army Medical Corps.

(*From the Pathological Department of the Royal Army Medical College, London.*)

Two recent papers emanating from the Vaccine Department of the Royal Army Medical College (Perry, Findlay and Bensted, 1933), have recorded (*a*) the assessment of the immunizing value of strains of *Bact. typhosum* in different phases by mouse protection tests, and (*b*) the antigenic variation of this organism by certain *in vivo* methods. Work on this subject of antityphoid inoculation has been continued with the object of obtaining some evidence that would correlate the results of these protection experiments in mice with the immunizing value of the vaccine in the human subject. Also to determine the most suitable modifications that should be introduced into the technique of manufacture of typhoid-paratyphoid vaccine to increase its efficiency. This communication is concerned with these further observations.

The Correlation of Immunity in the Human Subject with Protection in Mice following Inoculation with *Bact. typhosum* in Different Phases.

A field trial in endemic areas of the disease would, of course, supply the most satisfactory evidence of the immunizing power of any typhoid vaccine. The difficulties attendant on a test of this nature are very great and in the present circumstances cannot be overcome. To obtain unequivocal statistical evidence under conditions of natural infection would entail a standardized technique of laboratory diagnosis, a clinical and laboratory staff especially selected for this work, together with adequate controls. Opportunity may arise in the future to attain this ideal, but until such time as this is possible, field trials would only confuse the issue. In default, therefore, of this method of assessment of the value of the vaccine confirmation of the utility of mouse protection tests can only be obtained by recourse to laboratory tests that might be expected to yield evidence of any variation in response to the injection of different types of typhoid vaccine. The choice is restricted to methods by which more or less accurate quantitative estimation of immune substances can be made. Agglutination and bactericidal tests appear, therefore, the only alternatives available.

With regard to agglutination tests, it is agreed that flagellar agglutination is no measure of the resistance of the individual to infection (Felix, 1924, Arkwright, 1927, etc.). There is evidence, however, that the development of somatic agglutinins is some criterion of protection (Felix and Olitzki, 1926), but it is not universally accepted that the somatic titre has any quantitative relationship to the degree of immunity (Grinnell, 1932). Owing to the conflicting views that exist on the question it appeared desirable to obtain some further experimental evidence bearing on this subject.

For this purpose rabbits were injected with different types of typhoid vaccine; the animals were bled after suitable intervals, the sera inactivated and stored in sterile ampoules until required. Bacillary suspensions were prepared from cultures of typhoid bacilli in different phases. In addition, vaccines were made from the soluble specific carbohydrate factor combined with various proteins. The hapten was prepared after the method described by Bruce White (1929), and the non-specific protein factors employed were normal human serum and artificially roughened *Bact. paratyphosum A*.

The rabbit antisera resulting from the inoculation of these vaccines, and normal horse-serum employed as a control, were mixed with one or two minimal lethal doses of the test organism and immediately injected intraperitoneally into mice.

Table I shows the results of these experiments together with the "O" and "H" titre of each serum used.

It would appear from the results of the above experiments that, within the limits of the test, there is evidence of relationship between the "O"

TABLE I.

TO DETERMINE THE RELATIONSHIP BETWEEN THE AGGLUTININ TITRE OF AN ANTI-TYPHOID SERUM AND ITS PROTECTIVE VALUE.

Rabbit anti-sera	Agglutinin titre		Result of injection of mixture of serum and 1 M.L.D. of Bact. typhosum.	Result of injection of mixture of serum and 2 M.L.D of Bact. typhosum.
	H	O		
Anti-typhoid Si	1/125.	1/1500.	□ □ □ □ □	□ □ □ □ □ □ □ □ □ □
Anti-typhoid Sii	1/125	1/750	□ □ □ □ □	■ ■ ■ ■ ■
Anti-typhoid Rii.	1/30,000	1/250	□ ■ ■ ■ ■	■ ■ ■ ■ ■
Anti-typhoid S hapten and rough para A.	nil	1/25	□ □ ■ ■ ■	■ ■ ■ ■ ■
Anti-typhoid S hapten and human serum.	nil.	1/50.	□ ■ ■ ■ ■	■ ■ ■ ■ ■
Normal horse serum control.	nil.	nil.	□ ■ ■ ■ ■	–
Control without serum.	–	–	■ ■ ■ ■ ■	–

□ Mouse alive and quite fit 72 hours after injection.

■ Mouse dead within 48 hours from typhoid septicaemia

The amount of pure serum injected into each mouse was 0·5 cc and the 1 M.L.D or 2 M.L.D of organisms was contained in 0·25 cc.

agglutinin titre and the protective power of the serum. Owing to the nature of the test it is not possible to judge the comparative values of sera having " O " titres of 1-250 and less.

That immunity may be present even though no agglutinins are detectable in the sera appears evident from mouse experiments. It has been noted during the course of this work that the agglutinin response of mice following the injection of the usual types of vaccine may be almost negligible. For example, when a pure smooth vaccine was used, mice were fully protected against 2 M.L.D. of the test organism, yet the " O " titre of the serum was only 1-12·5. Further, mice injected with two doses of the purified specific polysaccharide of a smooth typhoid bacillus combined with the non-specific nucleo-protein of a rough paratyphoid " A " bacillus were fully protected against 1 M.L.D. of *Bact. typhosum*, but no agglutinins could be demonstrated in the sera. This protection of mice with hapten mixtures against subsequent infection with typhoid bacilli is analogous to the work of Avery and Goebel (1931) on the pneumococcus.

Owing to the low " O " titres which normally follow inoculation of the human subject with the usual two doses of typhoid vaccine, agglutination tests cannot be expected to yield comparative evidence of any immunity that may be present.

Methods of estimating the bactericidal property of the blood following injection of the vaccine thus appear to be the sole laboratory tests that can be employed with any prospect of success.

Whilst it is realized that certain criticisms have been made regarding the interpretation of bactericidal tests (Hale, 1930), the concensus of opinion is that they afford valuable comparative evidence of immunity. Investigation was therefore directed to the determination of the comparative bactericidal values of human sera following the inoculation of killed cultures of *Bact. typhosum* of varying antigenic composition. The difficulties of selecting the most satisfactory method of carrying out this test are too well known to need any emphasis. It will suffice to mention that all the orthodox methods have been tried in detail. The technique that yielded the most consistent results was a slight modification of that described by Felix and Olitzki (1926) as the plate-culture method of Neisser and Weschberg. The essential features of this method consist in the use of a standardized complement and the visual determination by colony counts of the number of organisms surviving after contact with an immune serum for a given period.

Six individuals were employed in the investigation. As a preliminary, samples of blood were obtained for the estimation of the normal bactericidal power of the serum. Later, the men were inoculated with different typhoid vaccines prepared by the routine method and standardized to contain one thousand million organisms per cubic centimetre. The dosage of the vaccine was 0·5 c.c. followed by 1·0 c.c. after an interval of ten days, and samples of blood were taken ten days after the second injection. The sera

from the preliminary bleedings and those obtained subsequent to inoculation were heated to 52° C. in a water bath for half an hour (to inactivate complement) on each of two successive days, and were stored in the cold until required for use.

Three different cultures of *Bact. typhosum* were employed for the vaccines; the first being representative of the organism in its most pronounced rough phase—obtained artificially by growth in immune serum—the second consisting of a culture in the pure smooth phase, and a third intermediate in character between these two extremes. Two men (A and B) were inoculated with the vaccine prepared from the rough organisms, two (C and D) with that prepared from the partially rough organisms, and two (E and F) with that prepared from the pure smooth organisms.

TECHNIQUE OF THE TEST.

Reagents.—(1) Human sera—inactivated by heating at 52° C.

(2) Complement—normal rabbit serum. The animal was selected by preliminary titrations of the serum and the titrations were repeated at intervals to ensure the minimal bactericidal action on the test organism.

(3) Test organism—chosen by preliminary estimations as not being unduly susceptible to bactericidal action.

Method.—The details regarding dilutions of the sera, etc., will become evident on reference to the tables. The only points, however, that may usefully be mentioned are as follows :—

(1) Difficulty may be experienced in making shake cultures that yield a uniform distribution of colonies. This can be obviated by thoroughly agitating the tubes containing the melted agar and the test mixtures and allowing them to stand for a few minutes to enable the bubbles to dissipate before pouring the plates.

(2) The counting of the colonies can most easily be effected by the examination of the plates under a dissecting microscope with a magnification of thirty diameters. The result is expressed as the total number of colonies in the plates. This figure is obtained by multiplying the average number of colonies in each microscope field by a factor representing the ratio of the area of the microscope field to the area of the plate. If the colonies should be so numerous as to be uncountable the result is expressed as a single infinity figure, whilst complete overgrowth of the plate culture is represented by a double infinity figure. It was found that with the magnification employed over 60 colonies per field—corresponding to about 55,000 per plate—approached the limit of possible enumeration.

(3) The culture of *Bact. typhosum* used to estimate the bactericidal property of the serum in all the tests was selected after estimating its resistance against fresh rabbit serum. It was noted that organisms showing the slightest sign of roughness were very

TABLE II.

Comparison of Increase of Bactericidal Power of Human Serum after Inoculation with Vaccines prepared from Rough and Smooth Cultures of *Bact. typhosum.*

Individual.	Dose of Serum in c.c.	Dose of other reagents etc	Total number of colonies on plates.	
			Before inoculation.	After inoculation.
A Rough Vaccine.	0·001 0·0005	To each dose of serum was added 0·025 c.c. of complement and 0·1 c.c. of a 1/100,000 dilution of a 24 hours broth culture of Bact. typhosum sufficient saline was added to each tube to make the final bulk 0·25 c.c. The mixture was left in contact for 4 hrs. at 37°C and shake plate cultures made from each tube.	28.000. 25,000.	20.000. 20,000.
B. Rough vaccine.	0·001 0·0005		35,000. 37.000.	25,000. 34.000
C. Semi-rough vaccine.	0·001 0·0005		17,500. 17,500.	18,000. 17,000
D. Semi-rough vaccine.	0·001 0 0005		31,000. 34,000.	25,000. 33,000.
E Smooth vaccine	0·001 0·0005		34,000 ∞	15,000. 25,000.
F Smooth vaccine	0·001 0·0005		33,000 ∞ ∞	10,000 26.000

Control plates — Immediate count 4,500.
Count after 4 hrs at 37°C ∞ ∞.

susceptible to the bactericidal action of this serum. This action was far less manifest on smooth organisms. The culture finally employed was a smooth type, and by conserving it in the pure smooth phase consistent results were obtained throughout the series of experiments.

Table II and the appended notes illustrate the results of this investigation.

It will be apparent from the above table that there is little or no difference between the increase in the bactericidal power of the serum of individuals injected with vaccines prepared from partially rough and markedly rough organisms. There is, however, a marked increase in the bactericidal value of the serum of the individuals inoculated with pure "smooth" vaccines.

Note.—It must be mentioned that the sera used in the above test have been stored in ampoules at a low temperature. The tests have been repeated on many occasions over a period of some months. The results have, in the main, been comparable, although occasionally a slight difference has been noted between the counts relating to the rough and semi-rough vaccines, as is shown below in the abridged table:—

Vaccine	Colony Counts	
	Before inoculation	After inoculation
Rough	6,400 5,900	6,600 6,600
Semi-rough	6,900 8,300	6,100 5,100
Smooth	7,800 9,200	2,600 1,200

The findings, have, however, without exception indicated the marked superiority of the smooth vaccine in raising the bactericidal power of the serum. It would appear that in the short immunizing process of two doses of vaccine to which individuals are usually subjected, the maximum increase in bactericidins is only produced by vaccines prepared from pure smooth organisms.

Confirmation of these results was obtained by mouse experiments. A series of bactericidal tests, employing the same technique, was made on the sera of mice immunized with rough and smooth vaccines. Forty mice were used in the test, twenty being inoculated with the smooth organisms and twenty with the rough. Ten mice from each group were retained for

protection tests, whilst the remaining ten were killed; the sera from each group were pooled and the bactericidins estimated. Table III illustrates the result of this test. Subsequent protection tests showed that the ten mice inoculated with the smooth organism were fully protected against 2 M.L.D. of *Bact. typhosum*, whereas the ten mice inoculated with the rough organism did not survive this test dose.

TABLE III.

COMPARISON OF INCREASE OF BACTERICIDAL POWER OF MOUSE SERUM AFTER INOCULATION WITH VACCINES PREPARED FROM ROUGH AND SMOOTH CULTURES OF *Bact. typhosum*.

Type of Vaccine	Dose of Serum in c c	Dose of other reagents etc	Total number of colonies on plates	
			Normal mouse serum	Immunized mouse serum
Rough.	0·005 0·0005	To each dose of serum was added 0.025 cc of complement and 0.1 cc. of 1/100,000 dil. of 24 hrs broth culture of Bact typhosum Saline was added to make final bulk 0.25 cc The mixture was left in contact for 4 hrs.	∞ ∞	16,400 5,800
Smooth	0·005 0 0005		∞ ∞	1,100 700

Control plates		
	Immediate count	3,100
	count after 4 hrs at 37°C	17,500

The results of bactericidal tests are greatly influenced by the details of the technique employed and it became evident during the course of this work that the essential factors, such as serum dilution, dose of organisms employed, and the period of contact of the mixture, require very delicate adjustment. It is not claimed that the figures that have been obtained are not open to criticism. It may, however, be stated that the reduction in colony counts, subsequent to inoculation, was not due to agglutination of the organisms, which has been one of the main criticisms of bactericidal tests employing colony counting methods. Investigation of this particular point has negatived such a possibility. The bactericidal tests were repeated with serum dilutions sufficiently high to exclude the influence of agglutination, the "H" and "O" agglutinin titres were estimated before and after inoculation, and results comparable with those given in Table II were obtained.

The foregoing investigations appear to prove that there is a definite correlation between the development of immune substances in the human subject and the results of mouse protection tests following the inoculation of typhoid vaccines. Smooth vaccines increase the bactericidal power of the blood and protect mice against subsequent lethal doses of living organisms, whereas vaccines made from rough organisms fail to produce either of these effects.

Preparation of Typhoid-Paratyphoid Vaccine.

In a previous communication (Perry, Findlay and Bensted, 1933) it has been mentioned that, as a result of mouse protection tests, the strain of *Bact. typhosum*, known as the Rawlings strain, had been discarded. This strain had been for many years included in the Army typhoid-paratyphoid vaccine, but deterioration in its protective properties had become obvious and substitution of a smooth culture of proved protective value was indicated. In addition, certain modifications in the method of preparation of the vaccine appeared desirable.

It may be mentioned, however, that since the above communication was published a note on work of a similar nature by Ahuja (1933), from the Central Research Institute, Kasauli, has appeared. This observer arrived at somewhat different conclusions, and states that he believes, as a result of his investigations, that a vaccine prepared from the "fixed" or "standard" type of the Rawlings strain of typhoid bacillus confers a degree of protection almost equal to that obtained with a vaccine prepared from a recently isolated strain of typhoid bacillus. It is not clear what the terms "fixed" or "standard" type of the Rawlings typhoid bacillus are meant to convey. Experience of this strain, which extends over many years, has made it evident that its behaviour under conditions of artificial culture is similar to that of any other strain of *Bact. typhosum*. The virulence and protective capacity of the organism are unstable factors, and depend upon the proportion of smooth surface antigens present in the culture. It is possible for these properties to vary in one or other direction according to the conditions of artificial environment. Whilst decrease in protective properties can be delayed by careful colony selection, the tendency is towards decadence and ultimate loss of efficacy as a vaccine, in spite of any cultural precautions that may be employed.

The first modification that was introduced in the preparation of the vaccine was the substitution of a smooth recently isolated strain of typhoid bacillus for the old Rawlings strain. The selection of this new strain was made on the basis of its proved efficacy in increasing the resistance of mice to infection and on the fact that its surface antigens were entirely smooth. Whilst this culture was salt stable undue importance was not attached to this property, which was emphasized in the article by Ahuja, as it has been shown by Grinnell (1932), amongst others, that stability in saline solution

is no criterion of the proportion of smooth antigens in the culture. Eleven out of twelve of the Rawlings rough cultures he worked with were salt stable.

Subsequently, certain *in vivo* methods (Perry, Findlay and Bensted, 1933) having shown that it is possible to produce pure smooth cultures of the Rawlings strain and its increased virulence and protective properties having been fully proved by mouse protection tests, it was decided to employ this rejuvenated Rawlings strain as the typhoid component. The suggestion is not made that it is superior to any other strain of typhoid bacillus in the same phase, but the choice has been made on its long association with typhoid vaccine. Obviously it is not the strain of the bacillus employed that is of importance, but that the emulsion from which the vaccine is manufactured should consist of pure smooth antigens only. The paratyphoid components of the vaccine (*Bact. paratyphosum* "A," Mears, and *Bact. paratyphosum* "B," Rowlands) remain unchanged. Animal experiments on the same lines as those undertaken with the typhoid bacillus have proved their suitability for inclusion in the vaccine. The numbers and relative proportions of the three organisms are also similar to that in the original vaccine.

An innovation has been introduced in the methods of preserving the strains. Previously, continuous subculture on inspissated egg-medium, to conserve as far as possible the smooth phase, was the rule. It has been found, however, that a more satisfactory method is to utilize the spleen of a mouse that has died of an experimentally produced typhoid or paratyphoid septicæmia. A mouse is inoculated intraperitoneally with a lethal dose of the organism, after its death the spleen is removed aseptically, dried *in vacuo* over calcium chloride, and stored in a sealed ampoule. It is uncertain, at present, how long the organism remains viable, but no trouble has been experienced in obtaining pure cultures of smooth organisms from this dried spleen after a period of four months.

The following are the details of the present method of manufacture of typhoid-paratyphoid vaccine :—

Typhoid Element.

Bact. typhosum, rejuvenated Rawlings strain.

(1) A small portion of the dried spleen, obtained in the manner described above, is inoculated into broth which is incubated at 37° C. for eight to twelve hours.

(2) The broth culture is plated out and the plates incubated for twenty-four hours at 37° C.

(3) The colonies that develop are invariably smooth, but in the event of the colonial appearance indicating a reversion, and loss of virulence, mouse passage, as described in the previous article (Perry, Findlay and Bensted, 1933), is undertaken. A typically smooth colony is marked by a ring.

(4) A tube of broth is inoculated from the marked colony and incubated for eighteen hours at 37° C.

(5) Three mice are inoculated intraperitoneally with 0·5 c.c. of a 1 in 5 dilution of this 18-hour broth culture. Employing the nutrient broth in use at the R.A.M. College, the bacterial content of this inoculum is approximately 50 millions, i.e. one minimal lethal dose. The inoculated mice should die within forty-eight hours from a typhoid septicæmia.

(6) A post-mortem examination is performed and plate cultivations are made from the heart blood.

(7) The plate should show a pure culture of smooth organisms and one discrete colony is selected. Subculture is made into broth tubes and also into the various carbohydrate media. The identity of the selected colony can thus be confirmed by its biochemical and serological reactions.

(8) A Roux bottle of unfiltered pea-flour tryptic-digest agar is seeded with the contents of one of the broth tubes and incubated for twenty-four hours.

(9) The growth is washed off in 300-400 c.c. of normal saline.

(10) The emulsion is sucked off by means of a vacuum pump into a sterile flask and provides inoculum sufficient for twenty or more Roux bottles.

(11) Each Roux bottle is inoculated with 15 c.c. of emulsion and incubated for forty-eight hours.

(12) Sterile saline to the amount of 80 c.c. is pumped into each bottle of medium and the growth washed off.

(13) A sample from each bottle is examined for purity by means of slide preparations.

(14) The emulsion from each bottle is sucked off by means of a vacuum pump into a three-litre graduated flask.

(15) The bulk of the emulsion is made up to the nearest multiple of 500 c.c. by pumping in sterile saline.

(16) Samples are removed for purity tests and bacterial count by the opacity method.

(17) The thick emulsion is heated for one hour at 53° C. allowing time for the centre of the emulsion to attain this temperature.

(18) Sufficient 5 per cent. carbol-saline is added to make a final concentration of 1 per cent. in the bulk. This is stored for forty-eight hours with occasional shaking.

(19) Sterility tests in fluid and solid media under aerobic and anaerobic conditions are made in the usual manner.

Paratyphoid Elements.

Bact. paratyphosum "A," strain Mears.
Bact. paratyphosum "B," strain Rowlands.
A similar procedure is followed.

(20) The three thick emulsions are mixed and diluted so that the finished vaccine contains :—

1,000 million *Bact. typhosum,*
750 million *Bact. paratyphosum* " A,"
750 million *Bact. paratyphosum* " B,"
in 0·5 per cent. carbol saline.

(21) The vaccine is filled into bottles or ampoules, and final sterility and toxicity tests, by mouse and guinea-pig inoculation, are carried out.

(22) The batch of vaccine is labelled with an expiry date which, at present, is calculated as one year from the date of manufacture of the thick emulsion employed.

Expiry Date of Vaccine.

In an earlier communication the desirability of ascertaining on some scientific basis the duration of potency of this vaccine was mentioned. It was noted that the expiry date of one year that had been affixed to the vaccine had been empirically selected. As recorded in this communication quantities of the vaccines used in the original investigations have been retained and stored both at ordinary temperatures and in the cold room. Mouse protection tests have now been undertaken at intervals of three months. Up to the present time—twelve months after the preparation of the emulsions—the vaccines have been proved to have fully retained their protective properties. It is possible, therefore, that further lapse of time will show that the present expiry date may be much extended. If this should be the case it will be evident that considerable economy would result in circumstances where it is essential that large reserves of vaccine should be available.

Reactions following Inoculation.

Some observations are desirable on the subject of the local and general reactions that are liable to follow the inoculation of typhoid-paratyphoid vaccine. In the earlier days, when this vaccine was first introduced into the Army, the severity of the symptoms following the injection of killed broth cultures proved a marked deterrent to this form of prophylaxis. With further experience, the intensity of these reactions was diminished by growing the organisms on an agar medium and employing a heavy broth inoculum. This method reduced the broth content in the finished vaccine to about five per cent. Notwithstanding this modification complaints were still received from time to time regarding severe general and local reactions.

Inoculation being on a voluntary basis in the British Army the importance of minimizing these post-inoculation effects was recognized. Special and detailed instructions are laid down in the Regulations for the Medical

Services of the Army (1932) regarding the precautions that should be taken after typhoid-paratyphoid inoculation. It became evident that indulgence in any severe form of exercise during the forty-eight hours following inoculation was one of the most important factors in producing undue reactions and this is particularly emphasized in these instructions. In addition, owing to the fact that intense reactions in animals followed the administration of broth vaccine, the technique of manufacture was further modified so that the final broth content of the suspension was reduced to a minimum. This procedure appeared to be justifiable as recent animal experiments have shown that saline suspensions of the organisms are as protective as broth emulsions.

It was considered possible that the severity of the after-effects might have been increased by the substitution of organisms more highly virulent than those previously employed in the vaccine. A number of experimental inoculations in the human subject were, therefore, undertaken to obtain some data bearing on this point before the issue of vaccines prepared from bacilli of a higher order of virulence.

Three vaccines were prepared, the paratyphoid elements being the same in each case, but the typhoid component in the first was the Rawlings strain of *Bact. typhosum* in its natural rough phase, in the second the Rawlings strain in its smooth phase and in the third a smooth recently isolated strain. Seventy-five men were used in the test and were divided into three batches. The inoculations were undertaken by an independent observer, the vaccines supplied were labelled with a serial number only and were without further indication of their exact nature. In this manner prejudice could not enter into the contrast of the resulting reactions. The vaccines were given in full doses, the temperature was taken before and after inoculation and careful observations were made of local reactions. The usual precautions advised after the injection of typhoid-paratyphoid vaccines were strictly observed and rest was enforced. In no case was there any general reaction that called for special comment, and the local reaction was not excessive. No difference was noted between the after-effects following the three different vaccines. It can, therefore, be safely assumed that the virulence of the organism injected—in the case of enteric vaccines—does not influence reaction to any extent, and that vaccines prepared from highly virulent organisms can be used for mass inoculation with safety, provided that the instructions issued with the vaccine are followed.

It must be noted that reactions of greater severity than usual appear to follow inoculations made during the warm seasons in the tropics. Ledingham and Balfour (1917) have emphasized that inoculations during the hot weather may be followed by excessively severe reactions and this has also been the opinion of those with experience of the vaccine under tropical conditions (Perry and Bensted, 1929). Administrative arrangements should, therefore, be made so that primary or reinoculations abroad are undertaken during the temperate season.

Reports have been received on occasion regarding severe reactions following the inoculation of troops on board ship and in consequence it seems advisable that all such injections should be completed before embarkation.

There remains to be mentioned a somewhat unusual delayed reaction that may not infrequently be observed. No untoward effect is noted at the usual period—six to eight hours after the administration of the vaccine—but malaise, rise of temperature and increased local reaction are complained of a few days later. This delayed reaction appears to be due to the liberation of toxins by rubbing or scratching the site of the injection as a result of the irritation induced by the inoculation.

Individuals will, however, be met with who display an especial sensitivity towards the inoculation of foreign proteins despite any precautions that can be taken. Apart from such individuals undue after-effects can in a large measure be attributed to neglect of the necessary after-care.

It is unfortunate that this neglect in the after-care of the inoculated individuals is still responsible for isolated reports of undue reactions. It is apparent that familiarity with the employment of the vaccine for many years has engendered carelessness in complying with the regulations that govern its use. One recent example may be quoted. A unit serving abroad carried out a series of reinoculations and reported, somewhat precipitately, intense general and local reactions. The same batch of vaccine had been employed in various stations at home and abroad without complaint. It subsequently transpired that the unit in question had undertaken these inoculations in the morning, during the hot weather, and that the individuals inoculated continued their ordinary duties, which entailed heavy exercise, throughout the day. It is not surprising, therefore, that the after-effects were unduly severe. A further example may be of interest. Amongst a batch of 15 men inoculated in a station at home one suffered from severe general reaction—rise of temperature with rigors—whilst the remaining 14 were not notably affected. This individual had, through a sense of misguided zeal, scrubbed a corridor a few hours after his inoculation.

It will be seen that every effort is made in the process of manufacture of the vaccine to produce a prophylactic which will yield the maximum possible protection with the minimum reaction. The latter desideratum can only be procured by the collaboration of the medical officer responsible for the injections.

Inoculation of Infants.

The fact that considerable numbers of children in the earlier years of life are still unprotected by inoculation when taken abroad is, no doubt, due to the mistaken idea of the severity of the reaction that may follow the inoculation and to the fact that the incidence of typhoid in this age category is not high. Experience both of the inoculation of children and of the occurrence of enteric fevers amongst infants abroad suggests

that these views have no real foundation. Provided that the dose is graduated, children from the age of two years onwards can be inoculated without anxiety, as the reactions are in no way unduly severe. For children from the ages of 2 to 4 years the most practical method is to dilute the ordinary vaccine ten times with normal saline, and of this diluted vaccine to administer two doses, 0·25 c.c. and 0·5 c.c., spaced by the usual interval. For older children—from 4 to 12 years—the ordinary vaccine should be diluted two and a half times, and two doses, 0·25 c.c. and 0·5 c.c., administered at the usual intervals.

Summary.

(1) An account is given of investigations made to compare the protective value of different typhoid vaccines by the correlation of mouse protection tests with the development of immune bodies in the human subject and in mice.

(2) Modifications introduced into the manufacture of the typhoid-paratyphoid vaccine are described.

(3) Some data bearing on the period over which the vaccine retains its potency are discussed.

(4) Comment is made on the local and general reactions following inoculation and also on the question of the employment of the vaccine for the immunization of children.

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HÆMOGLOBINURIA: A NEW PROBLEM ON THE INDIAN FRONTIER.

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CONTENTS.

Introduction.

". . . O! be some other name:
What's in a name? That which we call a rose
By any other name would smell as sweet . . ."

Juliet may be forgiven that. Even a doctor, in love, may be pardoned an equally questionable pronouncement; but no doctor, in full possession of his faculties, can be allowed to use a symptomatic diagnosis or title such as "hæmoglobinuria" without protest. Explanation or excuse will be expected of him.

I plead ignorance, and the admission is a serious one, because elucidation of the conditions which give rise to the sign of hæmoglobinuria has, in this case, become a matter of some urgency and importance.

This new problem on the frontier has now reached a stage where enlightenment waits upon intelligence, and the sooner and wider such intelligence as we have at our disposal is broadcast, the quicker is the puzzle likely to be solved.

This particular form of hæmoglobinuria is connected with malaria and/or with treatment for malaria. As a preliminary, the reader is asked to be lenient when requested not to confuse hæmoglobinuria with hæmaturia. As everyone knows, hæmaturia is one of the recognized complications of malaria. It may occur in an intermittent form [1] or it may come as an acute attack [2], and it is not as uncommon as many writers lead us to suppose.

We may leave hæmaturia at that and proceed now to consider a recent and hitherto unknown phenomenon on the Indian frontier: hæmoglobinuria in some way associated with malaria and confined to Indian troops and followers. So far, we have records of ten cases, with six deaths.

Can any of these cases be labelled malarial hæmoglobinuria, i.e., blackwater fever?

Are any of them due to plasmoquine toxicity?

These are the outstanding questions to which we now seek the answers. The evidence tends to show that both questions may be answered in the affirmative, but we are still in the dark regarding details of the ætiological processes involved.

Hæmoglobinuria is a symptom which occurs under conditions as varied as they are numerous [3]. Fortunately, we need not here concern ourselves with most of the divers causes, and alleged causes, of hæmoglobinuria. It will suffice to remember that their name is legion and to proceed at once to study the problem with one foot planted on the distinctive features and the other on the common characteristics of the cases now under review.

Geographical Distribution.

Geographical distribution is limited to the frontier, and the cases occurred by stations in the following order:—

1.	Fort Sandeman, Baluchistan	..	August 30, 1932
2.	Peshawar, N.W.F.P.	.. ..	Sept. 22, 1932
3.	Kohat, N.W.F.P. ..	.. ..	Nov. 20, 1932
4.	Quetta, Baluchistan	.. ..	August 2, 1933
5.	,, ,,	.. ..	,, 8, ,,
6.	,, ,,	.. ..	,, 8, ,,
7.	,, ,,	.. ..	,, 11, ,,
8.	,, ,,	.. ..	,, 11, ,,
9.	Wana, Waziristan, N.W.F.P.	..	,, 4, ,,
10.	Kohat, N.W.F.P.	.. ..	,, 13, ,,

That is, during the malaria season in 1932, three, and in 1933 (up to the month of August) seven cases of hæmoglobinuria were reported from the north-west frontier of India. These cases were scattered along a line extending for 250 miles, from Fort Sandeman in the south to Peshawar in the north. Five were isolated and five—in Quetta in 1933—were grouped both as regards time and place.

As there exists the possibility of blackwater fever, this geographical distribution must at once arouse the interest, and suspicion, of the tropical epidemiologist because, up to date, no case of blackwater fever in India has been reported west of longitude 75° (Amritsar).

The nearest point to that, in our present series, is on longitude 71·5° (Kohat).

The distance from Amritsar to Kohat is nearly 250 miles.

But although the occurrence at Amritsar of blackwater fever is mentioned in Manson's "Tropical Diseases" (1929) the observation is of no general significance: the Punjab is not a recognized blackwater fever area.

"The regions in India in which hæmoglobinuric fever is endemic are as follows: between the Ganges River and the Himalayas in Behar Province; between the Godavari and the Mahandi Rivers in the Madras Presidency; a region in the Punjab between Meerut and the Indus

River [4]; a region of which Nagpur is the centre; certain localities in the region of Bombay; and in Assam and upper Burmah" [5].

Byam and Archibald specify the Dooars, Assam, the Jeypore District in Madras, some parts of the Central Provinces, Bengal (Puruoia), and the Kanara District in the Bombay Presidency.

On page 71 of Rogers' and Megaw's "Tropical Medicine" (1930) there is a good blackwater fever map of India. From this it will be seen that a line drawn in a north-easterly direction from Surat, on the west coast, to Dehra Dun at the foot of the hills in the north, divides the country into hæmoglobinuric and non-hæmoglobinuric areas. The portion north and west of this line is clear, and Amritsar is therefore excluded.

"In places where malarial infection is limited to a brief season in each year the disease is uncommon or unknown, even though the malaria may occur as severe epidemics. It is decidedly rare in places which are visited at intervals of several years by epidemics of malaria, even when these are very severe as in the Punjab. It is practically unknown north of 40° N or south of 20° S."

Now the line Fort Sandeman-Peshawar lies well within these parallels of latitude, while Macedonia is actually north of 40° N. In Macedonia in the year ending October 31, 1918, there were 136 cases of blackwater fever with 36 deaths [6], and in Macedonia, malaria is just as seasonal as it is in the Punjab. The same is true of Italy, Sicily, Sardinia and Greece [5].

It is evident, then, that a northerly latitude and a seasonal prevalence of epidemic malaria do not necessarily preclude blackwater fever.

Of the exceeding rarity of the disease in the Punjab, Indian malariologists have no doubt. Sinton, in the discussion following Professor J. W. W. Stephen's paper on the "Hæmoglobinurias," stated: "he had no experience of blackwater fever, not having worked in such an area; for in the Punjab, in spite of the occurrence of intense autumnal malaria, largely subtertian, and of big periodical epidemics (such as that of 1908 which in three months killed 250,000 people out of a population of 20,000,000) no indigenous blackwater fever existed." Again on October 20, 1932, at the Royal Society of Tropical Medicine and Hygiene, Sir Rickard Christophers is reported to have said that: "The Punjab is not highly endemic. We know that the spleen rate over large parts of that area is only, say, five per cent, which is not worth considering. Certainly it is not a highly endemic area. There may be hyperendemic tracts, but in such places there is not usually the susceptible population of planters and missionaries such as we find in the blackwater areas in India. In the Punjab one would not expect to find blackwater fever judging by the malaria conditions. In India, on the other hand, those areas in which blackwater fever occurs are the areas which are picked out on the map as showing high endemicity, and wherever conditions have been carefully worked out the association has held good" [7].

This statement, from so eminent an authority, is arresting, because

every military medical officer in India knows that: (*a*) The Indian troops are heavily infected with chronic malaria; (*b*) when men are apparently "cured" and proceed on leave to their homes (in most cases situated in the Punjab), they nearly always rejoin their units with fresh malarial infections; (*c*) the majority of these men are not natives of the "hyper-endemic tracts."

We know that "the spleen index does not give so accurate an estimate of the amount of malarial infection existing at the moment as the endemic index, but, on the other hand, it gives a better idea of the degree to which malaria ordinarily prevails in the place." [8].

It is with surprise that one receives Sir Rickard Christophers' low estimate of about five per cent, especially in face of the following figures:

THE PUNJAB.

	Percentage of children with enlarged spleens	
Amritsar town	63·4	
Amritsar villages	87	
Palwal town	88	
Palwal villages	82	
Delhi	62	[9]

In the Chenab villages the percentages are given as 77, 75 and 59 for the years 1908 to 1910 [10].

The fact that these figures were obtained from areas which suffered heavily in the epidemic of 1908 does no more than mildly modify our surprise.

It will be noticed that when Sir Rickard Christophers uses the term "endemicity," he means the *constant* prevalence of a disease in a community. But, in the Punjab and on the frontier, although manifestations of malaria are not equal and constant throughout any one year, they are, generally speaking, fairly equal and constant over a period of years. Measured by the year, the disease is epidemic: its prevalence is periodic. Measured by years, the disease is endemic: its prevalence varies little.

These factors have been discussed in some detail, because the Punjab is the next door neighbour, and malariologically speaking closely related to that section of the frontier with which we are now concerned; and although the absence of blackwater fever in the Punjab has often been commented on and stressed, in this connection the frontier seems to have been left out in the cold.

The Indus divides the Punjab from that part of the frontier with which we are now dealing; but while this great river is a convenient, natural, and administrative boundary, its presence does not help to solve our problem because, up to a point, the country trans-Indus is much the same as the country cis-Indus. Thus, from a geographical standpoint, if hæmoglobinuria is unknown in the Punjab, there is no reason why it should occur in the plains of Peshawar and Kohat.

Beyond these plains topography undergoes a marked change, and we

find that Wana and Fort Sandeman are perched on sub-montane elevations, at heights of 4,500 feet and 4,600 feet respectively, in the ranges of Waziristan and Baluchistan. Hence, while these regions do not resemble the contiguous, far-reaching plains to the east, and have no geographical or climatic affinities at all with such districts as the Dooars and Kanara, they do possess many features in common with a known blackwater fever region in the west, viz., Macedonia.

Race, Caste, Age and Occupation.

The fact that all our patients were Indians is dead against a blackwater fever hypothesis. Europeans are more susceptible than any other race: the disease selects the immigrants rather than the indigenous inhabitants; and even if native troops and followers on the frontier be regarded as immigrants, we should still expect a heavier incidence amongst the British than amongst the Indians. Deaderick, quoting Daniels, says that although imported Indians are affected, they are only one-fourth as susceptible as Europeans [11].

Some further particulars of the patients—all men—are as follows:—

No.	Class	Age	Occupation
1.	Mussalman officer	45	Infantry
2.	Sikh officer	32	Medical
3.	Pathan N.C.O.	23	Infantry
4.	Baluch coolie	18	R.A.F.
5.	Mussalman sepoy	27	M.T.
6.	Baluch follower	38	Bakery
7.	Hindu cook	24	R.C.S.
8.	Hindu sepoy	28	Infantry
9.	Hindu follower	30	Cav. syce
10.	Sikh gunner	21	Artillery

With one exception (No. 8), all these men were natives of the Punjab or the frontier. The Hindu sepoy was a resident of Lucknow District, where blackwater fever—if it exists at all—is not common. Of the remainder, with one exception, none had lived in, or even visited, any blackwater fever area. This is not surprising, since the bulk of the personnel of the Indian Army, and the population trans-Indus, are born and remain west of the line Surat-Dehra Dun. With these classes there is very little coming and going between their native places and "down country." The exception was Case No. 1—an officer who had served in East Africa in 1915-16. He was admitted to hospital for malaria on August 24, 1932, developed hæmoglobinuria on August 29 or 30, and died on the latter date. He was diagnosed "blackwater fever" by a medical officer who had had previous experience of the disease. The patient's documents contain these remarks:—

"The signs were unmistakable to one who had seen cases of blackwater fever in East Africa during the War.

"Although there is now no documentary evidence in support, the late

jemadar, while ill in hospital at Fort Sandeman, told his brother (who was visiting him at the time) that his present illness was identical with the one he had in East Africa.

"Perhaps his service in East Africa had something to do with the attack of blackwater fever from which he died."

These remarks may be commented on thus:—

(*a*) The deceased's alleged statement comes to us secondhand, through the brother.

(*b*) Indian troops, and their relatives, are very much alive to the advantages accruing from "attributability to service in the field."

(*c*) This patient—like nearly all our Indian troops and followers—was an old malarial subject. The degree of splenic enlargement indicated that he must have suffered from repeated bouts in the past. Being an officer, it may be presumed that he "stuck it," with inadequate treatment. This type generally pays little or no attention to slight attacks of "fever." He goes to his sub-assistant-surgeon, gets a few doses of quinine, and carries on. No better preparation for blackwater fever could be imagined.

(*d*) Are we to believe that, when in East Africa, the patient was infected with a strain of parasite which remained alive, without giving rise to serious trouble, for a period of sixteen years; and that, at the end of that period, it suddenly flared up and killed him? If so, this series of events is not in consonance with the accepted life history of *Plasmodium falciparum*. It is true that this parasite may remain latent for quite a long time. "Maurel states that outbreaks of pernicious malaria may occur several years after return to France from the tropics, and without new infection" [12]; but it is too much to concede that *P. falciparum* will lie in the system of a soldier—exposed as he is to the climatic and physical exigencies of military service—in a condition so quiescent that, for a space of no less than sixteen years, the host has not a single admission to hospital prior to the fatal ending.

Malarial Parasites.

According to the case sheets, malarial parasites of the following types were identified in the blood smears: malignant tertian rings in four cases; benign tertian rings in four cases; benign tertian schizonts in one case. No parasites in one case—but this patient had a definite history of malignant malaria in 1929 and 1930, when malignant tertian parasites were found.

The apparent proportion of malignant tertian to benign tertian is therefore as 50 to 50. At this time, in all these stations, the malaria season was at its height and both forms of the disease were rife. In Quetta, the visitation was unusually severe. It is possible that some of the cases diagnosed "B.T." may, in reality, have been cases of mixed infection.

Further, it is not always easy, even for the expert, to differentiate benign tertian and malignant tertian rings with complete certitude: it may be impossible to come to a definite decision in the absence of more advanced forms of the benign tertian parasites. Hence, in the presence of rings

only, it is often justifiable to regard the label "B.T." with an open mind. Gordon Thompson has described, and demonstrated on slides, malignant tertian parasites showing unusually large rings. These parasites were obtained from the blood of patients in Rhodesia; but Sinton states that he has never met with such forms in India [13].

The latest work on this subject is suggestive; and I would respectfully urge those readers who are interested to study the *Transactions of the Royal Society of Tropical Medicine and Hygiene*, Vol. xxvi, pp. 204 to 240. Therein, Dr. George Giglioli brings forward fresh evidence in support of the theory that the causative agents of blackwater fever are special hæmolytic strains of malarial parasites. The disease "is the direct result of special hæmolytic strains or biological varieties of the plasmodium and more especially of *P. falciparum*; such strains, for the present, cannot be morphologically differentiated from the ordinary forms of malarial parasites." Also—"The epidemiology of blackwater is governed by: (*a*) The geographical and local distribution and incidence of such hæmolytic strains; (*b*) the degree of immunity of the population. Immune subjects may tolerate infection without giving clinical evidence of its nature by suffering from hæmoglobinuria."

Whether there is anything in this hæmolytic strain theory or not, modern thought is practically unanimous in favour of a direct connection between malarial infection and blackwater fever. Indeed, Megaw goes so far as to say that: "The association with malaria is so clear that the disease can rightly be called 'malaria hæmoglobinuria'" [14]. Deaderick is equally emphatic: "Ætiologically hæmoglobinuric fever stands in the same relation to malaria as do tabes and dementia paralytica to syphilis, and may, very properly, be regarded as a 'para-malarial' infection" [15].

Although Giglioli lays more stress on the hæmolytic character than on the type of parasite, the opinion and findings of most workers are contained in the remark of Rogers, that: "The parasite most commonly met with in blackwater fever is the malignant tertian, the other forms being rare" [16].

A table showing malarial incidence is appended [17].

Drugs: Quinine, Atebrin and Plasmoquine.

Let us now tackle the burning question in this series of cases—the part played by a drug, or drugs, in the production of the hæmoglobinuric state. On this point the recognized authorities are by no means unanimous, and the subject has given rise to as much controversy as the argument as to who won the War. Megaw says: "There is a good deal of evidence that quinine and repeated infections with malaria act together in some mysterious way to make the patient susceptible"; and he adds, as a reason for withholding the drug in the active stage of the disease, that: "Quinine is one of the common exciting causes of the disease, and therefore is likely to aggravate the hæmoglobinuria" [18]. Giglioli states that: "In individuals infected with hæmolytic strains (of parasites) the onset

of hæmoglobinuria may be determined . . . . by quinine . . . . Quinine and malaria being everywhere intimately associated, this drug, without being specifically the cause of blackwater, acquires an altogether special importance as it tends to increase the incidence of the disease in those areas where hæmolytic strains of the malaria parasites are endemic" [19].

Deaderick's conclusions are guarded. There is an excellent summary of the whole subject in pp. 160 to 173 of his book on malaria, already referred to [5]. Young [20] appears to be a left-winger: "It has even been said that quinine is the cause of blackwater fever. Veretas (Greece, 1858) originated the theory, and Tomaselli (Italy) and Koch later supported it. Much harm was done before this view was discountenanced, and it is now known that blackwater fever may develop without the previous administration of quinine. I have never seen any serious ill-effects following the use of quinine in the ordinary doses required for treatment, viz., twenty-four to thirty grains a day, and in the course of his large experience Sir Malcolm Watson has only seen one case of idiosyncrasy."

How does the quinine hypothesis affect the series of cases now under survey?

Prior to the onset of premonitory signs and symptoms of the hæmoglobinuric state, total amounts of quinine were taken thus:—

By	1 patient,	32	gr.,	spread	evenly	over	3½	days[1]
,,	1 ,,	50	,,	,,	,,	,,	2½	,,
,,	2 patients,	90	,,	,,	,,	,,	3	,,
,,	1 patient,	90	,,	,,	,,	,,	4½	,,
,,	1 ,,	110	,,	,,	,,	,,	5½	,,
,,	1 ,,	120	,,	,,	,,	,,	6	,,

The three cases in which no quinine was taken belonged to the Quetta group. Two died, and one was a very mild case which recovered.

As Major Young has pointed out, blackwater may develop without the previous administration of quinine [21].

But we are not entirely concerned with blackwater fever; and the Indian malariologist will go further by asking if we are concerned with that disease at all?

What is the evidence for and against plasmoquine poisoning?

Before dealing with the question of plasmoquine toxicity, it will be convenient first to dismiss atebrin, since this drug was given to the three cases mentioned above who received no quinine; and they were the only patients to whom atebrin was administered.

Prior to the onset of signs and symptoms of the hæmoglobinuric state, total amounts of atebrin were taken thus:—

By	1 patient,	1·5	grm.,	spread	evenly	over	5	days
,,	1 ,,	1·8	,,	,,	,,	,,	6	,,
,,	1 ,,	2·1	,,	,,	,,	,,	7	,,
,,	1 ,,	1·2	,,	,,	,,	,,	4	,,[2]

[1] This was followed by atebrin.
[2] This was preceded by quinine.

On this we may make three comments :—

(1) Hæmoglobinuria is not caused by an overdose of atebrin.

(2) Many cases of malaria have now been treated with this drug in military medical practice in India, and detailed records of the treatment have been kept and analysed. Certain manifestations of the drug's action are constantly noted, e.g., yellow discoloration of the skin, and persistent excretion of atebrin by the kidneys long after the administration of the drug has ceased; but it is now recognized that these are therapeutic, not toxic, effects. "The toxicity of atebrin is low" [22].

(3) Certain workers are of opinion that the action of plasmoquine is more or less intensified by the administration of atebrin. "When associated with plasmoquine its action may be compared to that of quinoplasmine; nevertheless, the addition of 0·3 of atebrin to 0·03 of plasmoquine appears to cause certain slight plasmoquine disturbances which do not occur when the same quantity of plasmoquine is administered together with 0·9 of quinine" [23].

So far as military medical practice in India is concerned, there is a mass of evidence to prove that, if atebrin and plasmoquine in association do "cause certain slight plasmoquine disturbances," these disturbances must be very slight indeed. Only one of our observers has remarked on this point. Writing on September 14, 1933, he says: "Recently I have been sc struck by the frequency of toxic phenomena in atebrin (plasmoquine) cases, that . . . I have suspended the treatment pending further orders." A communication was sent to this officer, and it ended thus: "What I am getting at is, of course, definite evidence of the malign evidence of atebrin. Up to date, as far as one can gather, it is a suggestion rather than a scientific observation."

On October 30, 1933, a telegram was received from the same officer. It read: "Recent experience with atebrin satisfactory, but supply exhausted. Please arrange supply four bottles 300 tablets each urgently."

There is no doubt that a fillip was given to the atebrin-plasmoquine toxicity view by certain occurrences on a tea garden in Assam: but these have been satisfactorily explained away [24] and now merely serve as a medical lesson with a moral.

Let us now consider the case of plasmoquine.

Prior to the onset of the premonitory signs and symptoms of the hæmoglobinuric state, total amounts of plasmoquine were taken thus:—

By	4	patients,	0·06	grm.,	spread	evenly	over	2 days	
,,	1	patient,	0·06	,,	,,	,,	,,	3 ,,	[25]
,,	1	,,	0·08	,,	,,	,,	,,	2 ,,	
,,	1	,,	0·09	,,	,,	,,	,,	4½ ,,	
,,	1	,,	0·10	,,	,,	,,	,,	3½ ,,	
,,	1	,,	0·13	,,	,,	,,	,,	4½ ,,	
,,	1	,,	0·18	,,	,,	,,	,,	6 ,,	

So, before the attack of hæmoglobinuria set in, six patients were on quinine, three on atebrin, one on quinine followed by atebrin, and all of them received plasmoquine.

The comparatively small dosages (daily, and total) of each of these drugs will be noted.

It is reasonably certain that some of the patients—and particularly those comprising the Quetta group—may have suffered from plasmoquine toxicity; and this form of poisoning has received a good deal of attention in recent tropical medical literature [26]. We may open the discussion with two quotations:—

"Quinine cannot be safely administered to such cases of blackwater fever because of the danger of producing further hæmolysis. On the other hand, plasmoquine can be safely used at any stage of the disease and apparently possesses sufficient action to control the infection until such time as quinine can be given. This drug should be equally useful in treating malaria attacks in individuals who suffer from hæmoglobinuria as a result of quinine intolerance" [27].

"Hæmolytic rabbit serum injected into dogs with a properly balanced dose of antilysin is harmless; quinine will upset this balance and precipitate hæmoglobinæmia and hæmoglobinuria. Cinconine, plasmoquine, antipyrin and phenacetin have no such action." The authors (Nocht and Kikuth) suggest that quinine plays a similar rôle in the presence of the hæmolytic substance which is responsible for malarial hæmoglobinuria [19].

Were it certain that all our cases were due to plasmoquine poisoning or idiosyncrasy alone, the optimism pervading these remarks as regards the use of the drug in blackwater fever might be received with satisfaction; but whatever the part played by plasmoquine in our series may have been, it is far from certain, yet, that accident or intolerance can account for the whole story. Hence, at present it behoves us to accept such statements with reserve, unless we belong to the not insignificant band of die-hards who deny the dangers of quinine therapy in hæmoglobinuria [28].

It is unsafe—indeed, it is impossible—to dogmatize, for the intimate pathological anatomy of, and processes concerned in, blackwater fever and other forms of hæmoglobinuria are largely matters of conjecture, and literature on the subject still pours out in an unending stream. For instance, one might take it as settled that hæmoglobinæmia is a certain forerunner of hæmoglobinuria; and that the greater the degree of hæmoglobinæmia, the greater the hæmoglobinuria. However, these are by no means accepted facts. Professor Warrington Yorke points out that: "Some deny the existence of hæmoglobinæmia in this disease (blackwater fever) and argue therefrom that the hæmoglobinuria results from a primary hæmorrhage into the kidneys. . . . What is certain is that the degree of hæmoglobinæmia is remarkably small" [29]. "In severe cases of the disease there was never any doubt about the presence of hæmoglobinæmia, but in the less severe cases it was, in many instances, difficult to satisfy oneself that hæmoglobinæmia much in excess of normal was present. Moreover, the phenomenon was usually of short duration in uncomplicated cases" [30]. "In paroxysmal hæmoglobinuria the serum is generally

stated to be of a red colour. In blackwater fever there is some doubt as to whether this is necessarily the case; and one of us with Dr. Stephens has recorded cases where hæmoglobinæmia was not evident. . . . We have only once seen hæmoglobin so great in amount as to give a rosy colour to the serum, and its presence is generally only indicated by an orange tint" [31].

When it comes to a question of blackwater fever *versus* plasmoquine poisoning, oxyhæmoglobinæmia with oxyhæmoglobinuria is indicative of the former; methæmoglobinæmia with methæmoglobinuria points to the latter. But differentiation is not just as simple as this bald statement might lead one to suppose, because, although oxyhæmoglobinæmia is not a result of plasmoquine toxicity, methæmoglobinæmia is frequently found in blackwater fever [32]. It would seem that, in plasmoquine toxicity, the conversion of hæmoglobin into methæmoglobin is an intra-corpuscular reaction, and that only subsequently is the methæmoglobin liberated into the plasma; but, when methæmoglobinæmia occurs in blackwater fever, its formation is not intra-corpuscular; the change to methæmoglobin occurs at some stage subsequent to the liberation of the hæmoglobin into the plasma. "In no case to my knowledge is methæmoglobin alone present" [33].

From what has now been said it will be plain that: (*a*) When hæmoglobinæmia is slight, very transient or even absent; and (*b*) methæmoglobinæmia and methæmoglobinuria are present, differential diagnosis is beset with pitfalls.

Sinton and other writers have presented us with a clear picture of what is known as plasmoquine poisoning. There is an excellent summary of this condition, and of the literature thereon, in pp. 195-196 of the *Tropical Diseases Bulletin*, April, 1933, Vol. XXX. "Severe toxic symptoms sometimes arise with startling suddenness, but more often the onset is less abrupt; cyanosis of the lips or griping pains are warning signs, and if the plasmoquine is stopped at once the symptoms pass off. If, on the contrary, it be continued, the cyanosis spreads to the palate, gums and finger-nails, the temperature rises and an attack resembling blackwater fever develops, accompanied by destruction of red cells, hæmolytic jaundice and black urine containing methæmoglobin . . . certain individuals are peculiarly sensitive to the drug. . . . Severe cases of poisoning are less common now that smaller doses are given."

Already the reader will have been struck by the close resemblance, especially on the clinical side, between blackwater fever and plasmoquine poisoning. Presently, we believe, he will notice that several of the cases in the series now under review more closely resemble blackwater fever than they do plasmoquine poisoning.

As regards plasmoquine dosage Sinton states that doses as high as 0·20 and 0·32 gramme daily have been given [34]. Dr. W. Fletcher quotes 0·18 gramme as not infrequent and 0·1 gramme per day as common. It will be remembered that, in the present series, the greatest amount taken was 0·18 gramme and that that amount was spread evenly over six days.

In discussing the dose of 0·03 gramme per day, Fletcher remarks that even this small amount has been known to produce hæmoglobinuria. "But, on the whole, it appears that this dose is reasonably safe, provided that it is given for a period of not longer than six or seven days without a break. Macphail treated several thousands of people in Guatemala with a daily dose of 0·03 plasmoquine combined with 20 grains of quinine over a period of six days, and toxic symptoms were observed in only one case. A daily dose of 0·02 gramme of plasmoquine, together with 24 grains of quinine, is the standard treatment on the United Fruit Company's plantations."

One of our patients took 0·04 gramme per day for two days, another had 0·02 gramme per day four and a half days, and the remainder were on 0·03 gramme per day, the average for these eight patients working out at a little over three days each.

Up to August, 1933, the standard dose throughout the Army in India was 0·03 gramme daily. This dose was based on results obtained from Army practice from the introduction of the drug in 1929 up to the end of 1932. These results indicated that this dose was safe, and that a dose of 0·02 gramme gave indifferent therapeutic action. In the case of the British troops mild toxity is occasionally noticed; severe poisoning has never been reported. But it is well known that the safety margin is small. "With the 0·04 gramme dose of plasmoquine daily there was definitely a slight cyanotic or greyish tinge noticed and one could always pick out the men in the ward who were on plasmoquine; it was especially noticeable in men who were attending hospital. The patients themselves did not notice it nor did they complain in any way. Men who were constipated appeared more prone to this cyanotic tinge. In the few cases in which cyanosis was marked, discontinuance of the drug for a few days with a brisk purge rendered the patients able to continue their course almost at once. It would appear that plasmoquine is cumulative. The reduction of the dose to 0·03 gramme daily prevented any cyanosis whatever" [34].

In the case of the Indian troops and as a direct result of the Quetta outbreak, the standard dosage was reduced fifty per cent as from August, 1933. Since that date no fresh cases of hæmoglobinuria have been reported, i.e., up to mid-December, 1933.

REFERENCES AND NOTES.

[1] GREEN'S "Encyclopædia Medica," 1917, vol. v, p. 450.

[2] BYAM and ARCHIBALD'S "Practice of Medicine in the Tropics," 1922, vol. ii, p. 1602.

[3] The literature on the subject is voluminous, e.g., see DEADERICK'S "Practical Study of Malaria," 1911. STEPHENS, in the *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 1927, vol. xx, pp. 401-411; and numerous other authorities.

[4] Here there seems to be an error in geographical definition or nomenclature.

[5] DEADERICK'S "Practical Study of Malaria," 1911, p. 35.

[6] JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, January, 1920.

[7] *Transactions of the Royal Society of Tropical Medicine and Hygiene*, November, 1932, vol. xxvi, pp. 232 and 237.

[8] ROGERS' and MEGAW'S "Tropical Medicine," 1930, p. 13.

[9] S. R. CHRISTOPHERS. "Malaria in the Punjab," *Scientific Memoirs of the Government of India*, 1911, No. 46, p. 15.

[10] "Paludism" (*Transactions of the Committee for the Study of Malaria in India*), edited by S. P. JAMES and S. R. CHRISTOPHERS, July, 1911, No. 3, p. 38. "The Relation of the Endemic Index to the Splenic Index in Epidemic Areas of the Punjab," by E. L. PERRY.

[11] DEADERICK. *Ibid.*, p. 154.

[12] *Idem. Ibid.*, p. 143.

[13] *Trans. of the Royal Society of Tropical Medicine and Hygiene*, 1927, vol. xx, No. 7.

[14] ROGERS and MEGAW. *Ibid.*, p. 73.

[15] DEADERICK. *Ibid.*, p. 153.

[16] ROGERS' "Fevers in the Tropics," 1910, p. 409.

[17] "Malaria, Indian Troops, 1932-33."

	Year	Month	Strengths	Admissions	Ratio per 1,000
Fort Sandeman ..	1932	Aug.	2,132	147	68·9
Peshawar ..	,,	Sept.	5,032	191	38·0
Kohat	,,	Nov.	3,892	221	55·5
All-India ..	1932		121,013	17,549	145·0
Quetta	1933	July	6,971	109	15·6
Quetta	,,	Aug.	7,414	361	48·7
Wana	,,	,,	2,701	294	108·8
Kohat	,,	,,	3,752	123	32·8
All-India ..	,,	Jan.-Sept.	114,699	10,913	95·1

[18] ROGERS and MEGAW. *Ibid.*, pp. 73 and 77.

[19] See "[7]," pp. 222-223.

[20] YOUNG, T. "Quinine Prophylaxis in Northern India," JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. lxi, p. 184.

[21] See also *The Indian Medical Gazette*, March, 1933, vol. lxviii, p. 149. In this communication N. G. BANERJEE and P. BRAHMACHARI describe a case of blackwater fever in which: (1) No hæmoglobinuria developed when the patient was under treatment with quinine; (2) an attack of hæmoglobinuria occurred when the patient was being treated with atebrin and plasmoquine; (3) the administration of the above drugs failed to avert an attack of hæmoglobinuria.

[22] "New Drugs in the Treatment of Malaria," W. FLETCHER. *Tropical Diseases Bulletin*, April, 1933, vol. 30, p. 199.

[23] Malaria Commission of the League of Nations. No. C.H. /Malaria./188, December 22, 1932.

[24] "The Non-Toxicity of Plasmoquine and Atebrin" (MCQUEEN); and "The Synthetic Anti-Malaria Compounds" (the EDITOR). *The Indian Medical Gazette*, June, 1933, vol. lxviii, pp. 323 and 339.

[25] It is uncertain whether, in this case, plasmoquine was given at all, and exhaustive inquiries have failed to clear up the point. Although the case is now reported and commented on as if the drug was, in fact, administered, the writer has not taken this course without misgiving. The following are the ascertainable facts:—

(*a*) The case sheet contains these entries, made by the medical officer in charge of the patient—

> "16 Nov., '32. Treatment: give atebrin, A.2. course, as follows: ·01 (*sic*: obviously stands for ·10) grm. at 08·00 hrs., 12.00 hrs., and 17.00 hrs. daily. Discontinue Mist. Quinine."
>
> "17 Nov. Continue A.2. course, i.e., atebrin, t.d.s., for 7 (seven) days."

The above course of treatment was stopped on November 20, the patient was given quinine, 10 gr. t.i.d., on November 21, and again from November 24. He died on November 26.

(*b*) The ward treatment book is kept up by, and is in charge of, the senior nursing sister of the ward. This book has been examined, and its entries are in agreement with the medical officer's case sheet.

Neither in the book nor in the sheet is there any mention of plasmoquine.

(*c*) In the hospital in question (Kohat) "A.2." stands for "Atebrin-Plasmoquine Course of Treatment," which consists of atebrin 0·3 grm., t.d.s., for seven days, followed by plasmoquine 0·02 grm., daily, for five days. Hence, if the patient's illness had pursued a normal course, plasmoquine would have been administered as from November 23.

(*d*) So certain was the medical officer that plasmoquine was out of the question, that he took special pains in investigating and writing up the case under the diagnosis of "Atebrin Poisoning."

This diagnosis is, of course, erroneous; but blackwater fever is possible and, since the fatal termination of the case, the medical officer has twice re-affirmed his conviction that no plasmoquine was given.

(*e*) Justifiable criticism has been aroused by certain entries on the patient's temperature chart. These entries have never been satisfactorily explained away. They are:—

"November	16	A.1.	
,,	17	A.2.	P.1.
,,	18	A.3.	P.2.
,,	19	A 4.	P.3."

The critics say that, in view of the patient's signs and symptoms, and of inability on the part of those responsible adequately to explain the above cryptic "P" entries, it is highly probable that 0·02 grm. plasmoquine was administered, daily, on November 17, 18 and 19.

It seems to us to be scientifically safer and sounder to give the critics the benefit of the doubt.

[26] For instance, see "[25]," p. 360: a letter signed by Captain G. S. Chawla, I.M.S.

[27] J. C. Paterson, in the *American Journal of Tropical Medicine*, September, 1932, vol. xii, pp. 363-368.

[28] For example, see "[7]," pp. 231, 236 and 237; also the *Journal of Tropical Medicine and Hygiene*, October 15, 1932, vol. 35, pp. 309-310.

[29] See "[7]," p. 233.

[30] G. R. Ross's "Researches on Blackwater Fever in Southern Rhodesia," 1932, p. 107.

[31] "Blackwater Fever," Christophers and Bentley, *Scientific Memoir* (*Medical*), *Government of India*, No. 35, 1908.

[32] See "[7]," p. 235.

[33] Ross. *Ibid.*, p. 110.

[34] "A Report on Six Hundred Cases of Malaria Treated with Plasmoquine and Quinine," H. B. F. Dixon, Journal of the Royal Army Medical Corps, June, 1933, p. 106.

(*To be continued.*)

THE CHITRAL RELIEFS: 1932.

By Captain M. G. de L'ISLE STURM.
Royal Army Medical Corps.

During the hot weather of 1932 I was stationed in Peshawar, commanding a detachment, about the strength of a Field Ambulance, of the Indian Hospital Corps. In operations on the Khajuri Plain, and in various other minor expeditions, I had formed a high opinion of the Indian Hospital Corps sepoy, whose stamina, pluck and cheerfulness are second to none. On hearing that a company of a Field Ambulance was to accompany the Chitral Relief Column in 1932, I volunteered to go with them, and was appointed Senior Medical Officer of the Column.

The company posted to Chitral came from the Indian Hospital Corps Depot at Rawalpindi, and joined my detachment for a little preparatory training. This consisted mainly of route marches over the neighbouring countryside: warm work in the month of August. The preliminary canter, a fourteen mile route march to Bara Fort and back, was accomplished without accident, although heatstroke under similar conditions and amongst seasoned troops, on this road, is not unknown.

The Column was due to assemble at Dargai on September 9, and the units drawn from Peshawar consisted of the Company of a Field Ambulance and two Animal Transport Companies of the Indian Army Service Corps. On the morning of September 4, we marched from the Connaught Lines, making for Pabbi, an unpleasant village halfway between Peshawar and Nowshera, and there we made the first halt.

The camping ground at Pabbi is fair, having the advantages of built latrines, and a plentiful, handy water supply, and the disadvantages of no shelter from the sun and an extremely dirty village close at hand. The water, though plentiful and convenient, was by no means pure, requiring five scoops of bleaching powder in spite of the fact that it had previously been heavily permanganated during a local cholera epidemic. The final concoction was nasty. Having settled in, I spent a few hours on the Kabul river in a "khisti" (ramshackle boat) with a gun, and bagged a brace of teal and a pintail: a pleasant diversion.

The onward march to Nowshera, where we were joined by a Mountain Battery, yet another Animal Transport Company and a Veterinary Detachment, was entirely without incident. At Nowshera we halted four days, and watched the Chitral Emergency Column pass through. Definite tribal opposition to the reliefs was expected from the Shamozai, so the powers that be had despatched the Chitral Emergency Column, officially known as "Cremcol," to encamp at Bandagai, on the Chitral road beyond Chakdara, to see the Relief Column proper, or "Chitcol," safely through. "Flycol"

(a military force, not an insecticide) was to come into being later, so it need not be discussed at present.

It is excusable to digress here and refer to the fate of "Cremcol" in their camp at Bandagai. Having chosen an excellent camp site on the edge of a malarial swamp, they were advised by the medical authorities to shift. They moved to a more sanitary site; but, judging from the amount of sniping (with several casualties) which went on during the next three nights, this new site seemed to be more exposed than the original one. Extra pickets put an end to the sniping—and also to the chaff levelled at the medical authority.

"Cremcol," although in 'buses and not on foot, sustained one fatal casualty en route, due to heatstroke. Here I should like to thank the Indian Army Service Corps for the unfailing supply of ice received by the Relief Column. Whatever the transport difficulties—and they sometimes appeared insurmountable—the ice was always received, and heatstroke casualties were certainly averted.

On reaching the next stage, Mardan, our best efforts failed to detect any signs of readiness for our arrival. We said that someone had blundered; and we felt exceedingly hot and bothered, for there is nothing on earth which will compensate for a lack of water for both men and animals. As usually happens in India, things came right in the end after a little trouble.

At Jalala, the stage between Mardan and Dargai, the water supply was inconveniently far from the camp, and the site itself was exposed and dusty. By this time we had been on the road long enough for me to realise that two of the chief difficulties, from a medical point of view, were inefficient sanitary policing and slackness of water discipline.

At every camp, shallow trench day latrines and urine pits were dug outside the perimeter in the required proportion, under supervision, while night latrines and urinals, in convenient sites, were placed within the perimeter. On leaving camp, these were filled in, limed, and marked "L." Unit sanitary police were employed. This was all very well; but the sanitary policing was not satisfactory, and indiscriminate defæcation was not strictly checked, with the result that camp sites in some places were considerably fouled, especially on the return journey. Had I had sufficient men, I should have drawn the entire sanitary police from the Indian Hospital Corps, but the reverse was the case: I had too few. However, the criticism has been made that these men have not sufficient prestige to deal successfully with the combatant troops, and probably this is true.

Every march was commenced with full water bottles. The first drink was taken at the discretion of commanders and thereafter at every halt. Water discipline was not always as good as it ought to have been, particularly as regards individuals; and on one occasion a wholesale breach of this form of discipline occurred, making one realize that we have not yet reached perfection in sanitary standards. In this case, admittedly, the circum-

stances were unusual, but it is to deal with unusual circumstances that discipline was invented.

Dargai was reached with no trouble, and here we were joined by the relieving Infantry Battalion, a Field Troop of Signals and a Field Company of Sappers and Miners. Here I met G. K. Graham, an I.M.S. subaltern in medical charge of the relieving battalion, who proved himself a thoroughly good fellow. Here, also, the Staff turned up, and paper began to fly about in the time-honoured manner.

We halted in Dargai for four days, and varied our work by short and very unprofitable shooting trips, and excellent bathing in the Swat Canal, in which Graham was very nearly drowned. He dived, very foolishly, right into the backwash of a strong weir. He will not, I think, repeat that performance.

Striking camp at Dargai, we marched over the Malakand Pass, without halting at Malakand itself, to Khar, one of the most delightful camps on the whole march. There is a plentiful and excellent water supply, and very good bathing facilities for both officers and men. At this time, however, the health of the men was being threatened from another direction. All sorts of itinerant vendors of dirty food, armed with "chits" from mythical potentates, camped on our trail like greedy vultures, and enticed the sepoys with their fly-blown sweetmeats. I had to deal with a mild epidemic of gastro-intestinal trouble which I traced to this source, but I experienced very little difficulty in getting rid of these pests. For this purpose I found the Dir Levies extremely helpful. The Dir Levies, subjects of the Nawab of Dir, are housed in small forts, known as levy posts, at frequent intervals along the Chitral Road. Their main purpose is to guard the road. The Nawab of Dir himself is a friendly tribal chief, who helps to picquet the Chitral Road during the through march of the column. His men are excellent and indefatigable, and can apparently do without sleep, as they seem to march by day and picket the hills at night. During both the outward and return marches they held the hills well and in force. Their uniform is nondescript, in contra-distinction to the Levies, who are picturesque ruffians, clad in white, with a safa embroidered in green and scarlet.

The march from Khar to Chakdara is an easy downhill slant. Chakdara Fort is actually in tribal territory, in land belonging to the Wali of Swat, and from here, winding ever upwards to the Lowarai Pass, starts the Chitral Road.

The Column being now fully assembled and well on the move, I completed details of a general administrative plan. Conservancy has already been described, and, of course, water was tested and dealt with in the routine manner. Sick parades were held in camp after the day's march. With the Field Ambulance Company were a number of riding mules for sick, all well-mannered animals, and invaluable for minor cases; also very much in demand by other units as mounts for quartermaster jemadars of

the "family man" type and babus of various sorts who were more inured to quill-driving than foot slogging. The problem of evacuation of casualties was simple as far as Dir. Up to this point the road was practicable for motor transport, and two six-wheeled ambulances accompanied us all the way, plying between the Column and the Indian Military Hospital at Dargai, which had been expanded into an advanced base hospital. One or both of the motor ambulances returned with casualties when necessary, with an adequate escort, rejoining the Column on completion of their duty. Sometimes the tactical situation forbade the immediate return of the ambulances, and in such cases casualties were retained until all was clear. On one occasion a considerable amount of heart-burning was caused by the unhampered passage of these motor ambulances to and fro, while some of the staff were forbidden the road on account of the tactical situation as judged from the other end. The sick were perfectly safe, however, as the road risks were judged by reports given by people on the spot.

To deal with casualties occurring on the march, the Field Ambulance Company was split up into an advanced medical detachment and a rear medical detachment. The advanced medical detachment was almost at the head of the Column, separated from the advance guard only by the Field Company, and the rear detachment, including riding mules, between the rear guard and the main body. The motor ambulances moved in bounds between the rearguard and the rear medical detachment. The object of this distribution was to ensure that casualties occurring on the march, either due to hostile action or otherwise, could be dealt with on the move. Thus, casualties occurring within reach of the advanced detachment were treated and taken along on stretchers, or left with an escort for the rear detachment to pick up, according to circumstances. Similarly, casualties occurring nearer the rear detachment were treated, and either carried on stretchers, or placed on mules or in the motor ambulances. Cases requiring more prolonged treatment were dealt with in one of the motor ambulances, which had been fitted up as a moving aid-post.

Also, the water testing and purifying apparatus was carried with the advanced detachment so that, when the water party of the Sappers and Miners broke off on nearing camp, to set up their tanks (when required), the medical arrangements were on the spot. As I accompanied the advanced detachment, I was enabled to leave the Column on nearing camp-sites, and go forward with the other representatives to help in arranging the lay-out of the camp. The bulk of the Field Ambulance transport, such as would not be urgently required on the march, was with the main body.

Prophylactic (*sic*) quinine was brought into use from Dargai. All units received ten grains of quinine in tablet form on six evenings out of seven. The parade took place after stand-to, and the quinine was personally administered to the troops by a sub-assistant-surgeon. During the quinine parade the men were barefooted, with their boots and socks laid

out for inspection, so that a foot inspection could be carried out at the same time.

In addition to Graham, who looked after the rear detachment, and myself, I had in my command one assistant-surgeon, a British nursing orderly and a sub-assistant-surgeon, all excellent fellows. Indeed, I was well served, and things ran on oiled wheels—an invaluable factor in a show of this kind.

After Chakdara came Serai, an unimposing place, and very dirty. Entering the camping ground, we met the Nawab of Dir. He had been hawking, with indifferent luck, was very tired and disinclined to talk. That night, after mess, accompanied by the rich Mahomedan who held the supply contract for the Column, the Nawab came to pay his respects to the Commandant. His followers were now well in evidence, and the surrounding hills were twinkling with the lights of their myriad pickets.

Between Serai and Sado sniping was anticipated as the Column crossed a low pass called Katgali Kandao. This is always a source of danger, as had been pointed out in operations at the beginning of the year by the Commander of the Malakand Force. Camp was struck well before dawn, and the Kandao was passed uneventfully, no shot being fired. Firing was heard as we neared Bandagai, where "Cremcol" was encamped, and assisted by mountain guns and aircraft was trying long-range conclusions with a few errant tribesmen. It was now light, and the road, winding along and over a high bluff called the Kamrani Sar, afforded a fine view of the surrounding country. The plumed smoke of the bursting shells, the near and distant crackle of rifle fire, the occasional spluttering of automatics and even the droning of planes seemed unreal and misplaced in the peaceful sunshine and quiet of the valleys and hills.

On the summit of the Sar I met Captain R. R. Leaning, R.A.M.C., who was in medical charge of "Cremcol." His camp had been heavily sniped during the last three nights, and his description of this diversion rendered the atmosphere somewhat sultry.

The short "Cremcol" campaign was remarkable for several things:—Firstly, the large amount of ammunition possessed by the tribesmen, and the reckless way in which it was expended: both unusual factors; secondly, the organized night operations carried out by the tribesmen, never previously attempted by this type of enemy; thirdly, the type of hostile ammunition chiefly used; and fourthly, for two really brilliant operations carried out by the Guides Infantry, who met and defeated the tribesmen on their own ground by employing their own methods of ambush.

Winding down the hill, the Column reached Sado and pitched camp. This was an excellent camping site, but I failed to see why the Sappers, when filling their 1,500 gallon canvas tanks, should include so much mud and so many twigs. However, a few words in the right quarter soon put things straight. On retiring to bed we were entertained by a sort of Brock's Benefit from the summit of the Sar, where a party of tribesmen

were unsuccessfully attempting to capture a picket, to the accompaniment of much small-arm fire and many Véry lights.

At Shamr-ud-Din we were met by a section of Armoured Cars, sent from Bandagai to accompany us as far as Warai. Here also the Political Agent met us. There were excellent bathing facilities at this place and, as both the officers with the Armoured Cars were friends of mine, we spent a very pleasant evening.

The march to Warai both started and ended unhappily. One of the armoured cars, rounding a tricky corner on a sandy surface, got into difficulties and went over the khud, falling ten feet upside down in a small stream. The Non-Commissioned Officer in the turret was pinned head downwards in the stream, and only saved from drowning by the prompt action of a sepoy in the Sappers and Miners who drained the stream short of the car by cutting through the bank with a spade, thereby lowering the level of the water below danger point. The door of the car was eventually forced open and the crew removed. The unfortunate Non-Commissioned Officer in the turret, in addition to being half-drowned, sustained a cracked rib and several minor abrasions. He was treated on the spot and left for the rear detachment to bring along in a motor ambulance. A working party of Sappers and Miners, with the remainder of the armoured car section and an additional escort, stayed behind to pull the wreck out of the ditch while the rest of the Column moved on. This was done in a very short time—good work, and the car was found to be still mechanically sound. On following the rest of the Column, a dispatch rider in the Royal Tank Corps was shot dead by a sniper from the other side of the river about two hundred yards off. The assassin was immediately chased by a number of Dir Levies. Whether or not he was eventually caught is unknown, but certainly a tribesman was produced later on for trial, after the Column had dispersed on its return to Dargai.

What eventually happened to the alleged murderer I do not know, as I left for England soon after. The whole thing seems shrouded in mystery. I was called to Malakand from Peshawar several weeks later to give evidence in the case. The alleged murderer and all the witnesses concerned stated that the unfortunate soldier was shot from above and from the right side of the road. I was not on the spot at the time, but I examined the deceased afterwards in Warai, and the bullet that entered his body had most certainly come from the left side and below the level of the road. All that I had heard from people on the spot confirmed this. The bullet entered just beneath the costal margin, pierced the spleen and emerged from the right side of the body in two pieces, making a double exit wound. I believe that my evidence at the trial conflicted with that of all the other witnesses, but I am not sure of this, and the ultimate result, as I have said, is unknown to me.

The body was brought into Warai camp; life was extinct on arrival and had been for some time. The poor remains were laid out as decently

as possible in a hospital tent, covered by a sheet and a Union Jack obtained from my Field Ambulance. Sniping was expected that night, and a general order was given to dig in. In all camps, from Chakdara onwards, hot water, dressings, tea, morphia, and complete emergency equipment were held in readiness in one of the hospital tents in case of casualties through sniping.

After "Lights Out" the sniping started in earnest, and sleep was out of the question. Owing to lack of time or for some other reason my tent was not dug in. I pulled my camp bed into the open air, lay down fully dressed and enjoyed a good view of the proceedings. There was a scuffle as the perimeter was reinforced, and I was highly amused at the spectacle of an individual walking about with a lighted hurricane lamp in his hand, and extinguishing it quickly after being greeted with a really fine flow of language emanating from some unseen but perfectly audible officer. The Column Commander and the Political Agent were in animated conference, and I heard the former scouting an absurd suggestion made by a third person that he should take a machine-gun outside the perimeter and put it on an isolated hill in the dark—shades of Duffer's Drift! I walked down to the hospital tent, finding all in order, and meeting on the way a large officer who was standing stock still, inspecting a rolled-up puttee, and wondering whether or not to don it. The sniping varied in intensity, and occasionally from different points of the compass some sportsman with a cavalry trumpet would sound the "charge"—a weird trickle of sound coming from the unknown blackness behind the grim, shadowy outlines of the hills.

By the grace of God, no casualties were sustained and, as the light grew, the firing died down completely.

The Column Commander, after ascertaining that the bridges on the road ahead were intact, decided to stay in camp till ten o'clock and then march the first six miles without a halt. First of all, the armoured cars returned to Malakand, escorting the ambulance bearing the dead soldier for burial. It was a long and gruelling march to Darora, and on this occasion occurred the breach of water discipline previously mentioned. The long, uphill pull into Darora at the end of the march caused casualties amongst mules, four of which died.

Darora was a good camp, although the water supply was too far away, and we were now getting fairly into the foothills. For dinner, some pheasant (kalej) were very kindly given us by the contractor, but unfortunately they were so well hung that I was obliged to condemn them. Tents were again dug down at night, sniping being expected, but none occurred. This was fortunate, for the troops were worn out by a long march started in the heat of the day, with the added labour entailed by manhandling army transport carts in the final lap. A second broken night would have been severely felt. It was an easy march from Darora to Dir. Here the column changed to a pack basis, dumping the carts at Dir to await the return of the relieved force. From here also the motor ambulances were returned to be relieved

by others, which met the returning column on its arrival at Dir. The change to pack took some time, but was efficiently carried out. At Dir we were met by the Political Agent of Chitral. I knew him, having met him at Saugor while he was still in the cavalry.

From now onwards to Drosh, all casualties were carried on stretchers and riding mules. Very few occurred, for the men were hardened, and minor injuries, which caused a certain amount of trouble in some units at the beginning of the march, were practically unknown.

A fairly steep climb took the column to Mirgha, where we were met by wild rumours about an Afghan brigand who was determined to shoot up the column in camp at this particular spot. He did not materialize, however, or perhaps his powder was damp.

The march from Mirgha to Ziarat is magnificent, traversing the Lowarai Pass, 10,600 feet, from the summit of which we were rewarded by a really fine view of the Chitral Valley. The weather was superb and the visibility excellent, so that the ten minutes' halt on the summit of the Pass more than repaid us for the dust and discomfort endured between Peshawar and Dir. The descent from the summit to Ziarat is steep, and all ranks were ordered to proceed dismounted. Ziarat is the most delightful spot imaginable, making a very pleasant hill refuge from the heat during the summer months in Chitral and Drosh. It is 8,000 feet high and, for once, the water supply did not require ruining with bleach. The water descends 5,000 feet in two miles from the snows of the Ashret Kandao, and does not pass any human habitation on the way. Here I very luckily bagged a hen koklas, which made a welcome addition to the mess fare.

At Nagar, the next stage, we were again near the Chitral River, which forms some fearsome eddies at an acute-angled turn near a huge rock. This, however, presented no terrors to the local inhabitant on his raft of planks and bladders. He negotiated the troubled waters with the ease, if not the grace, of a Red Indian shooting the rapids.

Marching into Drosh the following morning, we were met at the crest of a hill by the Mehtar of Chitral, the ruling chief, and his three sons. They showed us every hospitality and we took over from the relieved battalion amid a storm of conviviality.

One company of the relieving battalion had to take over from its opposite number at Chitral itself, marching from Drosh by way of Ayun. With them I sent a sub-assistant surgeon and the necessary medical equipment, and, having handed and taken over the relieving and relieved Field Ambulance Companies, I gladly accepted an invitation from the Political Officer to visit him in Chitral. Drosh and Chitral are connected by quite a reasonable motor road, although all the motor transport in the State is owned by the ruling family. This is understandable, as motor vehicles have to be manhandled over the Lowarai Pass in sections and reassembled in Drosh: an undertaking quite outside the means of the average military or civil officer in Government employ. The existence of

this road shows the possibility of keeping a motor ambulance in Drosh and, if this were done, there would be many advantages. At the present moment, there are two medical officers, one in Drosh and one in Chitral, both more or less bound to their respective stations, and of necessity unable to take much leave on account of the difficulty of reliefs. With a motor ambulance in Drosh, the one could relieve the other with ease, leave would be more frequent, and cases could be evacuated more easily. It should be added that the suggestion is not as ingenuous as it looks.

The return march was uneventful, except for one extraordinary chukor shoot in Dir, and the arrival of a flying column ("Flycol" previously mentioned) to meet us in Warai.

On our return to Dir we enjoyed the unlimited hospitality of the Nawab. All officers on the Column were given the choice between a chukor shoot and a tea-party, at which "chogas," a variety of decorative overcoat which makes an excellent dressing gown, were given away. Most of us chose the chukor shoot, and were led to the summits of the neighbouring peaks by the Nawab's beaters, regardless of the fact that a flushed chukor flies downhill. When the shoot started, naturally, the birds were beneath us, and, on being disturbed, flew down the nullahs, out of range. Eleven guns were out, and three birds were brought to bag by separate guns, too lazy, too independent, or too short-winded to come up the Khudside. On the other hand, three and a half brace were caught—yes, caught—by various oddments in hiding in the low ground at the very mouths of the nullahs. The exhausted birds, driven to the last gasp, were pounced upon as they fluttered or ran by wild Pathans, who flung themselves on the prey with the energy of tigers.

Although no hostile demonstration was made against the returning Column, a great deal was expected and, in consequence "Flycol" was formed and sent out to meet the relieved force at Warai, and accompany it to Dargai. "Flycol" was a flying column indeed. Officers were allowed twenty pounds of kit in all, including bedding (other ranks had much less), and it is just as well that the weather was late September and not, say, early January. There is such a thing as being too Spartan, and after every night that was the least bit chilly unmistakable signs of sleeplessness were in evidence next morning.

The relieved Field Ambulance Company was excellent. On the steep uphill march from Nagar to Ziarat, an exhausted sepoy in the battalion was carried on a stretcher the whole way by four ambulance sepoys without relief—an extraordinarily fine carry.

During the entire period of the outward and return marches, not one single Indian Hospital Corps sepoy reported sick, was crimed, or fell out on the march.

The Column reached Dargai and there dispersed, the Peshawar Animal Transport Companies accompanying "Flycol" to Peshawar, the infantry battalion entraining to Jhelum, the Field Ambulance Company to Rawalpindi, and other units to their respective stations.

DOWN SOUTH.

By U. P. A.

(*Continued from p.* 39.)

V.—The Return.

Fifty-eight miles from Dindigul, at the busy little town of Udamalpet, we turned south and made straight for the junction of the main ridges of the Palni, Animalai and Cardamom Hills. Twenty-two miles farther on, in the midst of the foothills, we crossed the border of Travancore State.

The remaining thirty odd miles provided us with a succession of thrills of the kind which prove the truth of the dictum, "Too old at forty." The road was very narrow and tortuous, the surface vile, and the gradients fierce. It wound along the face of precipitous cliffs following the valley of the Amaravati River. This river could be seen as a thin silver thread, thousands of feet below, a prodigious drop should anything go amiss. The hillsides were bare, and during the first part of the run the heat was intense, a forbidding, uncomfortable vale.

Quickly we rose to a height of 7,000 feet and reached the top of the watershed from which the river takes origin. The peak on the right of the defile is 8,841 feet high.

From this point the condition of the road improves and the scenery becomes attractive: woods, green fields and wide-flung tea and coffee plantations. The views are very fine.

After descending to Munnar (4,500 feet) we went on a few miles farther to an estate bungalow situated amidst beautiful surroundings at a height of 4,900 feet. Here the youthful chatelaine, born in the Corps, gave us a real Corps welcome.

The High Range, Travancore, is well worth seeing, particularly if you are so fortunate as to be the guest of that most hospitable person, the tea planter. Here you will find grand mountain scenery, a picturesque and interesting industry, and a community second to none in grit, kindliness and good cheer.

However, nowadays the planter is not the happy-go-lucky freelance he used to be. In the important tea districts of Ceylon, Assam, the Nilgiris and Travancore tea is highly organized, and, with a few insignificant exceptions, under the control of Big Business. Administration closely resembles the military pattern. I met a sort of tea G.O.C. with his brigade-major (engineer), staff-captain (chemist), and P.M.O.; and I saw a District Monthly Return of Output which was just like a District Monthly Return of Sickness. It was amusing to observe that the head tea man's inspection was voted to be an infernal nuisance and a waste of time and whitewash.

Also that the head tea man was treated with much deference and was always addressed as "Sir." His jokes never failed to get over no matter how hoary they might be.

When you do not know how the other half of the world lives, you may be mistaken in being envious: there is such a thing as jumping out of the frying pan into the fire.

The best route between Travancore and British India is by the new state road on the seaward face of the Western Ghâts, connecting with Cochin. We were unable to sample it, as our next objective was Ootacamund.

We left Munnar on April 8, and retraced our way to Udamalpet, thence turning west to Pollachi, and north to Coimbatore.

Coimbatore District lies at an average elevation of 2,500 feet. Except in the malarious foothills, it is healthy and windswept. It is separated from the Mysore plateau by several ranges, the biggest being the Bilirangan Hills. The latter form a double range, enclosing a valley 4,000 feet above sea level. This valley, with its boundary slopes, was covered with fine forests of valuable timber, notably teak, rosewood and sandalwood. In these forests and the high grass of the intervening glades were to be found wild elephant, bison, bear, tiger, leopard, ibex, antelope, several species of deer, hyæna, pig, wolf, etc., while the rivers were filled with mahseer: a sportsman's paradise.

Though the forests still stand, exploitation has played havoc with their virgin luxuriance; and though game is still to be found, excessive shikar—especially of the unauthorized sort—has sadly thinned the ranks. The plight of the bison is particularly bad because, some years ago, they were decimated by a severe epidemic of foot-and-mouth disease which started amongst the domesticated cattle of the villages.

After a chequered history, this district passed under the domination of Haidar Ali, to whom it was granted by the ruler of Mysore—Haidar then being in the Mysore service. In 1768 he and his son, Tipu Sultan, were turned out by the British; but they soon rallied, recaptured the area, and carried into captivity all the weak, scattered garrisons.

In 1783 the British again occupied the district, and restored it by treaty to Mysore. This restoration proved to be premature for, in 1790-91, Lord Cornwallis was forced to invade Mysore, while Tipu Sultan beseiged the town of Coimbatore. After five months the town was captured, and Tipu carried his prisoners to Seringapatam.

In 1792, Coimbatore was ceded to the British and, on the storming of Seringapatam and death of Tipu Sultan in 1791, the district passed under the administration of the East India Company.

It is curious that, although we are all more or less acquainted with the events of the Mutiny and the wars with Afghanistan and with the tribes of the north-west frontier. few of us know much about the stirring history

of southern India; and yet it was here that Sir Arthur Wellesley was schooled.

North of Coimbatore, at the foot of the Nilgiris, is Mettaipalayam, a picturesque little town, the railhead of the broad-gauge railway. From here, or from Coimbatore, via Erode, there is an excellent highway through the wooded semi-hilly district of Salem to Bangalore. For motoring purposes it is the best route to and from the Nilgiris. The northern road, via Mysore, is a good deal shorter, but its surface is very bad.

India is, for the most part, a country of the improvised and second-rate. Hence, it is a mistake to live there, continuously, for more than three or four years. (The official period of qualification for long leave ex-India is thirty-three months.) A capacity for gin and bitters is not the only distinguishing feature of the typical old "Koi Hai." More deplorable traits are complacency, acquiescence in the *status quo* and boredom in the presence of the first-class—for there are a few things in India which are in the front rank; and, in meeting these, you miss a lot of enjoyment if you are incapable of registering enthusiasm and surprise. For instance, there is the Taj Mahal at Agra, ditto at Bombay, the Kolahoi Glacier and the cemetery at Mian Mir; the Kulu Valley, the Sind Desert, the Mohurram and the Followers' Section I.H.C. forming fours. Each, in its own class, is wonderful.

Not the least amazing is the thirty-two mile hill road from Mettaipalayam to Ootacamund. Without doubt it is one of the finest mountain motor roads in the world, and a joy to travel over. It is skilfully graded and cambered, broad, smooth and with easy corners; and the scenery and views over its entire length are fascinating.

Coonoor and Wellington, contiguous to each other, lie at a height of 6,000 feet, twelve miles from Ooty and at the south-east corner of the Nilgiri plateau. They enjoy an excellent climate, and are noted for tea, golf, rejuvenated officials on retired pay, and debilitated officials on privilege leave and on no pay at all.

Ootacamund and the Nilgiris are like Srinagar and Kashmir, or Millbank and the Vauxhall Bridge Road—so well known that they need no description: so renowned, that to mention them is to court wild enthusiasm—which is apt to become tiresome—or flat contradiction—which is bad for the nerves. The ordinary man is well advised to contemplate such places in silence, and to leave the voicing of their charms to the troubadours and poets.

Talking of poets—have you ever noticed the affinity of poesy and pathology? It may be that I am a sympathetic person: I hope so: anyhow, my collection of pathological poetry grows apace. Or is it because the pathological poets like to share the fruits of their inspiration with all and sundry, and irrespective of sympathy? Or is it because they are

determined you shall swallow their effusions, whether you are poetically inclined or not? Certain it is that the pathologist, of all folk, most resembles the blacksmith, in that he fears not any man.

The last little laboratory valentine arrived yesterday: verbena-scented, mauve note-paper. Here it is (published without permission):—

Do the spots on Fusiliers
Adorn the soles of Grenadiers?
Is the little beast a tick
That's sending stalwart soldiers sick?
Simla's worried, H.-P.'s fussed;
Is N.Y.D. or Typhus wu'st?
Mosquito, louse or tick or bug or
What is tickling Ahmednagar?

Another pathologist was asked by the C.M.A. to explain a sudden accession to the guinea-pig ration strength. The reply to the C.M.A.—with a copy to me—reads thus:—

My Caroline, in order to console
Herself in loneliness, plumped for a brood of piglets four;
But, ignorant of methods of control,
Produced the four, five times: that is to say, a tidy score
Alas!
Surely you will not blame her, C.M.A.?
Nor cut her gram or bran? Have you no little babujis
Who, day by day, and scorning Fate—at play
Laugh and grow fat on ghi and gur and clamber on your knees?
Alack—
That you should ban to my dear Caroline
The golden chains which fasten thee to thine.
Thy name is mud:
May every foul bacillus in my lab. invade thy blood!

The remainder of the poem is not fit for publication in any periodical not specificially devoted to modernity, since it proceeds to consign the C.M.A. to a lunatic asylum, lepers' ward, in language as realistic as revolting. Still, it is pleasing to note that, for the first time on record, the controller of military accounts succumbed at once and without further argument. There is nothing the Oriental admires as much as a family of Carolinian dimensions, or fears as much as a poetical curse.

Caroline is still alive, and is cheered and comforted in her old age by a multitude of lusty descendants.

One must not be too critical or too severe. "Wassermann morning" must be very trying; and a succession of organisms "morphologically identical with K.L.B." (whatever that may mean) surely merits an occasional rest in the arms of Calliope.

Perhaps, some day, one of our eminent pathologists will settle down in Ooty on retired pay and become the Bard of the Blue Mountains.

Before leaving Ooty one must say something about the Todas—the remnant of the aboriginal inhabitants of this district. The origin of these people seems to go back to a dim and distant past, and is still hidden in the mists of conjecture. In physique, ethnology, archæology, culture and language the Todas are isolated and unique. They appear to have no affinities with any other Indian race. They are a peaceful, pastoral people to whom the buffalo is Life—spiritual as well as material; in fact, the buffalo is to them what money used to be to us. They are handsome in a wild, uncouth way; and they have many strange manners and customs, including the practice of polyandry. As a rule they are quite friendly and full of fun, and a visit to one of their bigger villages is an amusing and interesting experience. The entertainment will include part-singing, and for the small sum of one rupee you will get more verses than there are words in the Song of Solomon.

What is the secret of the survival of the Todas, and of their unruffled contentment and happiness in a world plagued with poverty, discontent and strife?

The answer is: the cow.

Why, then, should we not follow the example of this primitive race, and substitute the cow for the sovereign or sterling—or whatever is supposed to govern our destinies?

It seems to have been proven beyond doubt that the sovereign, etc., are utterly useless and subversive, whereas we know well that the cow is full of good deeds and altogether beneficent.

Suppose, for instance, that we had to pay America another instalment of the War Debt. This might take the form of a million Highland cattle, two million Ayrshires, three million red Herefords, four million Devon shorthorns and five million Jerseys—say, fifteen million in all.

In order to replace this mighty herd, we should all have to go back to the land, work hard and—in consequence—gain everlasting happiness. Those of us who could be spared would be engaged in building ships to transport the animals and, on the day the armada sailed, we might be able again to sing, "Britannia Rules the Waves," without feeling shamefaced about it.

By this form of payment the U.S.A. also would solve her unemployment problem. Half a million new cowboys would be enrolled for byre-conservancy duty. All the corn in the great Middle West would be consumed to keep the fat stock in condition, and all the cotton in the Southern States would be woven into *jhools* to keep the beasts warm in the winter time. The builders would be busy, for all the bank premises would have to be altered and enlarged to accommodate current accounts (steaks, joints, ox-tails, etc.), savings bank accounts (salted butter and cheese) and deposit accounts (tinned cream and maconochie).

The negro problem would be solved likewise. All the surplus negroes would be mustered as cattle-men for the Atlantic passage; and arrangements would be made with the British Government for the disposal of all such personnel found to be in possession of saxophones, banjoleles or jazz music. On a ship's arrival at Southampton, Liverpool or Glasgow, the heads of all incriminated negroes would be tapped smartly with heavy sledge-hammers, after which the offenders could be converted into fertilizers for the purpose of forcing the grass necessary for the oncoming herds.

Further, India and America would discover a bond of union in the sacred cow and the golden calf. No doubt Mr. Gandhi would embrace us on both cheeks, and obtain advantageous terms, for the export of billions of India's noble remnant—with a safeguard against canning, of course. This would immediately clear up the Indian tangle, and endear us to our American cousins as never before. The gift of a handsome pedigree cow will infallibly melt the heart of the hardest American—not excepting Mr. Hearst or the chairman of the foreign relations committee.

There is no end to the heavenly possibilities of such a scheme; people would be so busy milking cows and dodging bulls, that they would have no time for fighting or for attending any more conferences; in fact, we should have attained the long-looked-for Millennium.

On June 1, we bade Ooty a reluctant farewell and made for Mysore, 100 miles away, by the northern road.

The first part of the route, over the rolling downs of the Nilgiri plateau, is good going. Then there is an abrupt descent, very steep in parts, with sharp corners, and a bad surface. The hillside is densely wooded, but here and there you can obtain a wonderful view of the plain below. Next come the foothills, through which runs the Mysore State boundary. This zone is also covered with forest, largely composed of tall clumps of bamboo. It is stocked with game, including wild elephant. Finally there is a stretch of uninteresting plain, over which the car bumps and rocks as the objective, Chamundi Hill, is gradually approached.

The State is dotted with a large number of huge, isolated, rocky outcrops, some of them towering to 5,000 feet; and, as their summits often afford a good water supply, many of them were, in the old days, crowned by strong fortresses.

Chamundi Hill is situated two miles south-east of the city, and is 3,500 feet high. Chamundi is another name for Kali, the consort of Siva. The summit of the hill may be reached by a flight of steps but, thank goodness, there is also a fine, modern motor road to the top. Here there is a temple to Kali, and a pretty little summer-house where, in the hot weather, the maharajah sometimes rests in the cool of the evening.

The colossal figure of Mandi, Siva's bull, is worth seeing. It is a finely executed sculpture, hewn out of the solid rock: date, about 1675. The bull is in the recumbent attitude and, even so, is sixteen feet high.

These curious rocky outcrops are natural, but another prominent feature of the Mysore landscape is artificial—the water. All over the country you come across lakes or "tanks" which are often so extensive that it is hard to believe that they are man-made. One of them, Sulekere, is forty miles in circumference. They are usually in series, and are part and parcel of the irrigation system.

Mysore State was originally inhabited by wild, aboriginal tribes. Their descendants are still to be met with in the remoter parts of the country. Following these primitives came Buddhists, Jains, Brahmins, Mussalmans and Christians. From this it will be readily understood that Mysore has had a lively history.

With the fall of the old capital, Seringapatam, in 1799, Mysore's long life of storm and stress ended, and a period of lean years culminated in the classic famine of 1876-78, the result of failure of four successive monsoons. This was a terrible visitation. Thousands upon thousands of countryfolk crowded into Bangalore in hopeless confusion and despair. They died in the streets, of starvation, at the rate of forty a day. Government poured grain into Bangalore, but there was neither a scheme, nor any means, of distribution. At first sight this may seem to be a glaring piece of ineptitude, but is it not an example, on a small scale, of what is happening throughont the world to-day?

In 1881 the British Government founded the system of administration which is now in force and, since then, the State has made such rapid and sound progress that it is by far the most advanced of all the native States, and much more advanced than many parts of British India.

The common tongue is Kanarese. Café's Telegu, Noir's Tamil and our Urdu were useless here.

Mysore (i.e., "Buffalo Town") City is a worthy place. It is well planned, with broad streets, fine buildings, artistic monuments, beautiful gardens, an efficient police force and a conservancy establishment which really does a job of work. *Actually, the city is clean*!

The maharajah's palace is rather tawdry and flimsy, but it is of secondary importance to the palace in Bangalore. It contains the famous coronation chair, presented by Auranzeb in 1699.

The diwan's house was built originally by Wellington (then Colonel Wellesley) for his own use.

To see Mysore City in all its glory, you should arrange to visit it during the Dusehra festival. This festival is to Mysore what the Wagner celebration is to Bayreuth, or Shakespeare's birthday is to Stratford-on-Avon. However, Mysore always seems to be *en carnival*; from the city, the illuminated Chamundi looks beautiful; and to view the lights of the city from the hill is to catch a glimpse of fairyland.

The loveliness and variety of much of the scenery in Mysore is due to the fact that the State occupies the southern angle of the east and west

Ghâts, where they converge and commingle in the Nilgiri plateau. In addition to this, a ridge, which runs north and south, forms the dividing watershed of two great rivers, the Kistna (or Krishna) and the Cauvery.

From Mysore our route followed the line of the western Ghâts. It presented a wondrous succession of wild hills, rich valleys, swiftly flowing streams and thick forests of tropical luxuriance. As far north as Belgaum we travelled by the lesser roads to the west of the main highways. As a result we had to pay a goodly sum in tolls to the Mysore road fund (*sic*) but it was well worth it; the long drive through these magnificent jungles left an impression which neither Georgina nor I will ever forget. And here, alas, I fail! I'm sorry about this but—not being a W. H. Hudson—description is impossible.

Ten miles north-east of Mysore is Seringapatam. It is approached through a crowded bazaar. Here Georgina stopped the car and created a diversion by soundly spanking a small boy who was tormenting a tethered fowl. The bystanders—including the offender's mamma—were too astonished to protest. Clear of the bazaar, we crossed a bridge, and were then on the island of Seringapatam, in the Cauvery River. The island is three miles long by one broad, and contains the fort, an ancient temple dedicated to Ranganatha—a big and imposing building—the Gumbaz or mausoleum of Haidar Ali and Tipu Sultan, and the summer garden and palace where Colonel Wellesley resided.

To see Seringapatam properly, you should arrange to halt for three or four hours.

We made straight for the dâk bungalow—a clean little place, carefully sited on a grassy patch overlooking the river and facing the Wellesley bridge. The butler, a Mussalman, said he knew all the sights. So he did: at least, he knew their locations, but he was utterly ignorant of their names, uses or history. The result was that, when he said: "Stop, Your Honour," we had to consult the map and then fend for ourselves. Georgina intoned a chant from the guide-book while I gazed wildly around, trying to identify the dungeon in which the British were kept, in chains, for years and years: the exact spot where Tipu met his doom: the durbar site, and the harem where Haidar emulated Blue Beard.

There is no worse method of sight-seeing. According to the Georginian chant, Seringapatam became the capital of Mysore in 1610. Although between 1638 and 1771 it sustained eight sieges, it never fell to the enemy: he was either beaten off or bought off.

Haidar Ali and Tipu Sultan, foreseeing trouble with the British, extended and strengthened the fort. Nevertheless, when we first besieged the place, in 1792, we gave Tipu such a bad time that he submitted to terms. Thereafter, further strengthening was carried out so that, on being besieged a second time (1799) Tipu put up a stout and prolonged resistance.

Eventually the fortress was carried by storm in a very gallant manner, and Tipu fell in the closing stage of the assault.

Contrary to the opinion of many people to-day, the Great War was not the only war: there were a few brave men in days of old.

The ramparts of the fort are very fine. They should be viewed first from the main bastion, near the breach made in 1799. This vantage point will give you some idea of the courage and determination of the attacking troops, who had to cross the broad river under heavy fire before actually engaging in the assault.

While I was trying to visualize Georgina's intonation—"Cheering madly, the foremost troops made for the breach"—Sri Purshottamnadas Venkatachalaiyam (hereinafter referred to as "S.P.V.") joined our little party. Obviously he was a Hindu. All the same, he lifted his cap. He said: "Good morning, sir and madam. Do you require a guide?"

"Good morning. We hate guides."

"Sir and madam, your present conductor—though doubtless a worthy man—knows nothing. I, Sri Purshottamnadas Venkatachalaiyam, am university student, and quite aware of all historical facts of my native land."

We fled, closely followed by Café, Noir and the D.B. butler. We scrambled into the car and hurried off to the picturesque watergate, near where it is said Tipu met his end. However, before Georgina had finished her chant about this sector, S.P.V.—who had borrowed a cycle—tracked us down.

"Good morning, sir and madam. Do you require a guide?"

Again we beat a speedy retreat. This time we covered from three or four miles at top speed. We saw the old bungalows once inhabited by the surgeon and by the director of ordnance to the Mysore *raj*. These officials were Englishmen, and their bungalows—fully furnished—and gardens are still kept as they were a hundred and more years ago. These places are full of interest and, like everything else in Seringapatam, are in excellent condition. By reason of this, the Mysore administration merits our grateful thanks.

In spite of furious pedalling, S.P.V. just failed to catch us.

However, on reaching the Darya Daulat—the summer garden and palace—S.P.V., who had taken a short cut, received us at the entrance.

S.P.V. was a youth about twenty. He had a pleasant face, a good manner and spoke English well. His clothes, though decidedly threadbare, were neat and clean. He told us all about the frescoes on the wall-coloured panoramas depicting Colonel Baillie's defeat in 1780, Haidar's triumph and Tipu's procession, etc.

We soon found that S.P.V. was as good as his word in so far as his country's history was concerned. He knew what to tell us and how to tell it; and when we had "done" the place thoroughly we felt sorry we had avoided his acquaintance earlier in the day.

"And now, S.P.V., we must go. By the way—is this your regular occupation?"

"Oh, no, sir! I am a fourth-year medical student, at present on holiday. But times are hard. I shall be grateful, sir and madam, if you can spare me a rupee."

The Mysore medical student does not seem to be very different from his prototype in other parts of the world—in one respect, at any rate.

In Mysore, Medicine is now a close preserve. Pursuant to the prevailing nationalistic sentiment, the state medical school was moved from Bangalore to the capital; and, as a M.B.(Mysore) is not allowed to practise in England, so it has been decreed that a F.R.C.S.(Eng.) shall not be allowed to practise in Mysore. This is called Reciprocity on the Self-Determination model. If the shade of Mr. Woodrow Wilson ever looks down on our wonderful world, it must find it difficult to believe the evidence of its own eyes.

From Seringapatam we struck north-west over the hills to Shimoga, a rough drive of 150 miles. There are good rest-houses at Hassan, Arsikere and Shimoga. You can cut out Hassan by driving direct from Channarayapatna to Arsikere over a road—a very bad one—which is not shown on the map.

Leaving Shimoga on the morning of June 4, we reached the Gersoppa Falls in time for tiffin.

We first visited these Falls early in December, and that is the time to see them at their best. Before the monsoon there is too little water to make a spectacle, and during and after the monsoon the view is entirely obscured by dense clouds of mist and spray which rise from the depths of the ravine. Besides, during the latter period the river is so swollen and turbulent that the ferry-boat from the north—or British—side is unable to cross to the south, or Mysore side; and, to realize the full beauty of these falls, you must view them from both banks. The south bank is unapproachable except by this ferry.

The Falls are 18 miles east of Gersoppa village. We have mis-named them, and perpetuated the mistake on our maps. The local and correct name is Jog Falls. They are situated on the Sharavati River, 30 miles from the sea. The water drops down a sheer cliff in four cascades—the Rajah (or Horseshoe), the Roarer, the Rocket and La Dame Blanche.

At this point the river is 230 feet in breadth, and the drop is 830 feet.

Compare this with Niagara: Horseshoe Fall, breadth 2,600 feet and height 155 feet; American Fall, breadth 1,400 feet and height 165 feet.

The volume of water which pours over Niagara is much greater than in the case of the Gersoppa or Jog Falls; but nothing can surpass the effects of the latter's tremendous height and unspoiled beauty. In these respects it can have few—if any—rivals in the world.

There are a number of well-situated vantage points at various levels on

both banks. If you wish a minor thrill, you should scramble down the south bank and, from the bottom of the chasm, look upwards. If you desire a major thrill, you may lie on a narrow, projecting ledge of rock high up on on the north bank, wriggle forward—your ankles firmly grasped by your relatives, friends and servants—and look straight down into the depths of the boiling cauldron 850 feet below—that is, if you can.

That is what Hell must look like: terrifying but beautiful, horrible but magnetic.

After this, a certain amount of bravado concealed the fact that I had a ghastly sinking feeling in the epigastrium—but I wanted to have another look. Georgina said: "No. My turn." Well, it wasn't my fault. Her inspection lasted about $\frac{1}{100}$ of a second. She gave a quick gasp, wriggled back like an electrified lizard, lost her colour, told me off for a foolhardy knave and marched us off the rock.

In the early afternoon a lovely rainbow forms across the foot of the falls and, as the sun gradually declines, the rainbow slowly mounts until it spans the top of the falls—an entrancing sight. At times, the moon, too, throws a faintly tinted light across the belt of spray.

On great occasions—when the Heaven-born visit the place—Bengal lights, burning straw, charred wood and similar articles are floated over the falls. The cascades and clouds of spray are thus lighted up in a way which produces an amazingly weird effect.

In the dâk bungalow on the British side there is a visitors' book full of interesting names and entries. Many of the latter are early Victorian and, if somewhat heavy, are of a high literary standard. It would be difficult to find a more inspiring natural sight than the Jog Falls.

Next day we arrived in Karwar after a grand forest drive, via Sirsi and Yellapur, of about 125 miles.

Karwar is the north-west district of North Kanara. The port is the only safe haven on this coast between Bombay and Cochin. At one time it promised to be of importance on account of a projected extension of the railway from Hubli. The extension did not materialize, and now Karwar is merely a small coasting and fishing place and a resort for holiday-makers who spend all their time—sleep and meals excepted—in the sea.

One day, Charles—the Charles who packed the butter into our thermos—was neither eating nor sleeping; that is to say, he was bathing.

He is a peaceful, inoffensive person.

Imagine his alarm and surprise when a minnow suddenly darted at him.

Charles side-paddled.

The minnow missed, sulked for a moment, and then made a second and more determined attack on its quarry.

This time Charles spread-eagled his legs, and the minnow just failed to butt him on the right patella.

Charles is like most quiet men when roused; he has a temper which

effervesces *pari passu* with delay. As the minnow flashed past, Charles grabbed it by the tail. Unfortunately, the little brute whipped round and bit him on the shoulder.

Charles let go.

The rest of the story I had from Mrs. Charles. It is best told in an expurgated form.

It seems that Charles thought that a white-hot spear had been thrust through his deltoid.

He said so.

The whole arm became intensely painful, swollen and red, and Charles said things about that too. Then, poor chap, he became too ill to talk much; but he made up for this later on, during convalescence.

The acute stage lasted for two or three days, during which the limb became completely paralysed. It was not until about the tenth day that Charles really felt himself again.

On the assumption that the minnow must have died of shock, Charles bathed on the eleventh day. He carried with him a pickle fork, but, I am glad to say, had no occasion to use it.

Inquiries amongst the local fishermen, at the headquarters of the Bombay Natural History Society and elsewhere, failed to clear up the mystery, and this so preyed on Charles's mind that he resolutely refused to send an account of the incident to the press. I suggested that the CORPS NEWS AND GAZETTE would be glad to publish a short description of the affair, but the suggestion was received with quite unwarrantable asperity.

Personally, I think that Charles must have bumped one of the "Emden's" derelict torpedoes. That ship spent some time in the Indian Ocean before delivering the famous bombardment of Madras. Charles avers the thing was no bigger than a sardine; but then, if there is one thing Charles hates more than another, it is exaggeration.

Karwar harbour covers the seaward expansion of the estuary of the Kalinadi River. Its mouth is protected by the picturesque Oyster Rocks. A few miles to the south of this barrier lies the Portuguese island of Anjidiv. Across the water, to the north, may be seen the tree-clad hills of Goa. The whole scene is delightful.

This, however, is New Karwar. Old Karwar—now in ruins and scarcely discernible—was a different place. It was a noted centre of trade, intrigue and strife, and its history provides many illustrations of the difficulties and dangers which faced the traders and seamen of old. Here, in 1660, Sir William Courten's Company started a muslin weaving factory which, for a time, proved a great success. As the venture prospered and grew, a valuable export trade in muslins, pepper, cardamoms and cassia was established. Sivaji started the trouble, but was bought off for what was then a large sum: Rs. 1,120. Of course, the germ of blackmail spread to all the local chiefs and freebooters, with the result that, although the

factory continued to show profits, conditions were more or less precarious during the ensuing forty years.

In 1684 the factory was the centre of a serious disturbance, when the crew of a small vessel landed, carried off a cow, and killed the animal.

Troubles arising from Portuguese enmity and Dutch jealousy were constant. Then the Maratthas built a fort in the vicinity, and so threatened the factory that it had to close down from 1720 to 1750. It then reopened for two years, but was finally put out of action by the Portuguese in 1752.

We stayed at Karwar for a few days, and then made for Poona via Yellapur, Haliyal, Khanapur and Belgaum—a run of about 320 miles, which we did in two stages.

On arrival in Poona I found a letter awaiting me. The postmark was "Jullundur." The missive ran thus :—

"Protector of the Poor—Salaam !

Over a long time your servant has not been praying for your Honour's return to Punjab. Likewise my wife and two children—both males, praise be to God—have not been praying for your Honour's and Memsahib's daily arrivals.

Your Highnesses—Salaam !

God Almighty—to whom all thanks are overdue—at last answers united fervent prayers now arranging your Honour's transfer to Punjab, thus your old servant's heart is full to bursting of high tensions.

Send wire at once. Also fare to Poona, where your slave may attend to conduct your Honourable Bahadur and Memsahib to Punjab, via B.B. and C.I. Rail-gharri.

Sing to the ALL-POWERFUL (from whom all blessings are overdue) for that your Honour's return to the care of this unworthy chap.

Send fare, also advance of pay and *rassad*—URGENT.

Ever praying for your long lifes and prosperities,

Your old servant,

NABBHI BAKSH (Bearer)."

Aha, the Hop again !

I have neither information nor orders.

And yet, this is not the first time the Hop has startled me with the same sort of letter.

We shall see. Coming events cast their shadows before ; and when the shadow takes the form of a shrewd little Punjabi Mussalman, it would be unwise to treat it with contempt.

A return to the north ?

Ah, well, no matter! At any rate, we have been DOWN SOUTH.

Editorial.

THE CHEMISTRY OF FLESH FOODS AND THEIR LOSSES ON COOKING.

In the past ten years scientific research on foods has been mainly devoted to the subject of vitamins, and the old view that a diet is a question of proteins, fats, carbohydrates and calories has received little attention.

The earliest comprehensive food tables were compiled by König in 1882, from his own and other people's analyses; proteins, fats, carbohydrates, total ash and water were given. Seventeen years later the well-known tables of American foods prepared by Attwater and Bryant appeared; in these measurements of the inedible portion were given. In the next fifteen years little was done in this country. Following on the outbreak of war in 1914, the War Office was gradually faced with the problem of preparing diet tables for millions of men. It was then realized how few analyses of English foods existed, and Professor R. H. A. Plimmer was asked to make a complete analysis of the common British foods. Determinations of refuse were made and edible portions analyzed for proteins, fats and carbohydrates. The total ash was determined and the chlorides were returned as sodium chloride. This was the first time that an inorganic element had been included in a systematic food analysis. Plimmer pointed out that "the proper basis of the food value of meat should be of the lean. This part of the meat is eaten by all people, and it suffers very little loss during cooking. The amount of fat in meat is diminished during cooking and, further, individual taste may discard the whole or part of the fat. The fat content is thus indeterminable for the individual, and it is not possible to give a figure for the energy value of meat as eaten. A minimum calorie value is that of the lean." Plimmer, therefore, analysed the lean and the fat separately.

Following on the recognition of rickets as a deficiency disease, analyses of calcium and phosphorus began to be made; and a study of the anæmias caused interest in the determination of iron.

The most recent food tables in Germany have been made by Schall, and where the information is available he has included figures for potassium, sodium, calcium, magnesium, phosphorus, iron, sulphur and chlorine.

All the analyses made hitherto have been of uncooked food, in which form most of it is never eaten; also, the loss on cooking has not been determined, so that for the construction of individual dietaries the tables now available have been considered unsatisfactory. With the object of obtaining more exact information on the composition of cooked foods, the Medical Research Council made grants to Dr. R. A. McCance for systematic analyses of food as it is actually eaten, and the figures he has obtained

therefore apply mainly to cooked material. He has also studied the cause and the extent of the various losses brought about by cooking.

In the analytical procedure each joint of meat or piece of fish was weighed before and after being cooked. The edible portion was then removed and the waste or the edible portion weighed. In the case of fish there was no difficulty, but with meat a very real difficulty arose in dealing with the fat. Gross fluctuations in fat content were found to be an important cause of variation in the nitrogen and salt content of meat. Fat and lean, therefore, were analysed separately.

The Report on McCance's work just issued by the Medical Research Council contains full information on the procedure adopted for the determination of total nitrogen, non-protein nitrogen, purine nitrogen, carbohydrate, fat, total phosphorus, chlorides, sodium, potassium, calcium and magnesium. The analytical methods used for gravies and drippings were the same as those employed for meat.

In the tables showing the composition of cooked foods the method of cooking is given, and also what has been included for the edible portion. In stating the analytical results the amounts of the various organic constituents have been expressed as grammes, and those of the inorganic constituents as milligrammes, per 100 grammes of edible matter. Two factors (F_1 and F_2) are also given. By multiplying the given figures by F_1 the quantities which can be obtained from 100 grammes of the food as served can be ascertained. Similarly, multiplying by F_2 gives the amounts from 100 grammes of the raw food.

As an example: an analysis of beef sirloin with bone, roasted and underdone in the centre, gave 26·8 grammes of protein per 100 grammes, and F_1 is recorded as 0·80 and F_2 as 0·64. Therefore, $26·8 \times 0·80$ gives the protein in the meat as served, viz., 21·44 grammes per 100 grammes of beef, and $26·8 \times 0·64$ indicates the protein in the meat before cooking, viz., 17·15 grammes per 100 grammes of the raw food.

The figures for F_1 and F_2 vary with the food and the method of cooking. In stewed steak F_1 is given as 1·00 and F_2 as 0·57; for grilled mutton chops F_1 is 0·49 and F_2 0·31.

These elaborate tables will no doubt be very useful to the physician who is making out a dietary for a particular case of disease, but for the calculation of the food required by a body of soldiers we prefer to use the tables given by Plimmer. In McCance's tables there are no figures for calories, and these would have to be calculated, as we still require the diet to furnish a certain number of calories and to contain a certain amount of first-class protein. Plimmer gives the calorie value per 100 grammes, per ounce, and per pound.

McCance gives very full information about fish, and in one of his tables (A) an attempt is made to include all the fish usually eaten in this country. Each fish has been given its full zoological name as well as its popular name. Some of the fish may be unfamiliar to most

Also that the head tea man was treated with much deference and was always addressed as "Sir." His jokes never failed to get over no matter how hoary they might be.

When you do not know how the other half of the world lives, you may be mistaken in being envious: there is such a thing as jumping out of the frying pan into the fire.

The best route between Travancore and British India is by the new state road on the seaward face of the Western Ghâts, connecting with Cochin. We were unable to sample it, as our next objective was Ootacamund.

We left Munnar on April 8, and retraced our way to Udamalpet, thence turning west to Pollachi, and north to Coimbatore.

Coimbatore District lies at an average elevation of 2,500 feet. Except in the malarious foothills, it is healthy and windswept. It is separated from the Mysore plateau by several ranges, the biggest being the Bilirangan Hills. The latter form a double range, enclosing a valley 4,000 feet above sea level. This valley, with its boundary slopes, was covered with fine forests of valuable timber, notably teak, rosewood and sandalwood. In these forests and the high grass of the intervening glades were to be found wild elephant, bison, bear, tiger, leopard, ibex, antelope, several species of deer, hyæna, pig, wolf, etc., while the rivers were filled with mahseer: a sportsman's paradise.

Though the forests still stand, exploitation has played havoc with their virgin luxuriance; and though game is still to be found, excessive shikar—especially of the unauthorized sort—has sadly thinned the ranks. The plight of the bison is particularly bad because, some years ago, they were decimated by a severe epidemic of foot-and-mouth disease which started amongst the domesticated cattle of the villages.

After a chequered history, this district passed under the domination of Haidar Ali, to whom it was granted by the ruler of Mysore—Haidar then being in the Mysore service. In 1768 he and his son, Tipu Sultan, were turned out by the British; but they soon rallied, recaptured the area, and carried into captivity all the weak, scattered garrisons.

In 1783 the British again occupied the district, and restored it by treaty to Mysore. This restoration proved to be premature for, in 1790-91, Lord Cornwallis was forced to invade Mysore, while Tipu Sultan beseiged the town of Coimbatore. After five months the town was captured, and Tipu carried his prisoners to Seringapatam.

In 1792, Coimbatore was ceded to the British and, on the storming of Seringapatam and death of Tipu Sultan in 1791, the district passed under the administration of the East India Company.

It is curious that, although we are all more or less acquainted with the events of the Mutiny and the wars with Afghanistan and with the tribes of the north-west frontier, few of us know much about the stirring history

of southern India; and yet it was here that Sir Arthur Wellesley was schooled.

North of Coimbatore, at the foot of the Nilgiris, is Mettaipalayam, a picturesque little town, the railhead of the broad-gauge railway. From here, or from Coimbatore, via Erode, there is an excellent highway through the wooded semi-hilly district of Salem to Bangalore. For motoring purposes it is the best route to and from the Nilgiris. The northern road, via Mysore, is a good deal shorter, but its surface is very bad.

India is, for the most part, a country of the improvised and second-rate. Hence, it is a mistake to live there, continuously, for more than three or four years. (The official period of qualification for long leave ex-India is thirty-three months.) A capacity for gin and bitters is not the only distinguishing feature of the typical old "Koi Hai." More deplorable traits are complacency, acquiescence in the *status quo* and boredom in the presence of the first-class—for there are a few things in India which are in the front rank; and, in meeting these, you miss a lot of enjoyment if you are incapable of registering enthusiasm and surprise. For instance, there is the Taj Mahal at Agra, ditto at Bombay, the Kolahoi Glacier and the cemetery at Mian Mir; the Kulu Valley, the Sind Desert, the Mohurram and the Followers' Section I.H.C. forming fours. Each, in its own class, is wonderful.

Not the least amazing is the thirty-two mile hill road from Mettaipalayam to Ootacamund. Without doubt it is one of the finest mountain motor roads in the world, and a joy to travel over. It is skilfully graded and cambered, broad, smooth and with easy corners; and the scenery and views over its entire length are fascinating.

Coonoor and Wellington, contiguous to each other, lie at a height of 6,000 feet, twelve miles from Ooty and at the south-east corner of the Nilgiri plateau. They enjoy an excellent climate, and are noted for tea, golf, rejuvenated officials on retired pay, and debilitated officials on privilege leave and on no pay at all.

Ootacamund and the Nilgiris are like Srinagar and Kashmir, or Millbank and the Vauxhall Bridge Road—so well known that they need no description: so renowned, that to mention them is to court wild enthusiasm—which is apt to become tiresome—or flat contradiction—which is bad for the nerves. The ordinary man is well advised to contemplate such places in silence, and to leave the voicing of their charms to the troubadours and poets.

Talking of poets—have you ever noticed the affinity of poesy and pathology? It may be that I am a sympathetic person: I hope so: anyhow, my collection of pathological poetry grows apace. Or is it because the pathological poets like to share the fruits of their inspiration with all and sundry, and irrespective of sympathy? Or is it because they are

determined you shall swallow their effusions, whether you are poetically inclined or not? Certain it is that the pathologist, of all folk, most resembles the blacksmith, in that he fears not any man.

The last little laboratory valentine arrived yesterday : verbena-scented, mauve note-paper. Here it is (published without permission) :—

Do the spots on Fusiliers
Adorn the soles of Grenadiers?
Is the little beast a tick
That's sending stalwart soldiers sick?
Simla's worried, H.-P.'s fussed;
Is N.Y.D. or Typhus wu'st?
Mosquito, louse or tick or bug or
What is tickling Ahmednagar?

Another pathologist was asked by the C.M.A. to explain a sudden accession to the guinea-pig ration strength. The reply to the C.M.A.—with a copy to me—reads thus :—

My Caroline, in order to console
Herself in loneliness, plumped for a brood of piglets four;
But, ignorant of methods of control,
Produced the four, five times: that is to say, a tidy score
Alas!
Surely you will not blame her, C.M.A.?
Nor cut her gram or bran? Have you no little babujis
Who, day by day, and scorning Fate—at play
Laugh and grow fat on ghi and gur and clamber on your knees?
Alack—
That you should ban to my dear Caroline
The golden chains which fasten thee to thine.
Thy name is mud:
May every foul bacillus in my lab. invade thy blood!

The remainder of the poem is not fit for publication in any periodical not specificially devoted to modernity, since it proceeds to consign the C.M.A. to a lunatic asylum, lepers' ward, in language as realistic as revolting. Still, it is pleasing to note that, for the first time on record, the controller of military accounts succumbed at once and without further argument. There is nothing the Oriental admires as much as a family of Carolinian dimensions, or fears as much as a poetical curse.

Caroline is still alive, and is cheered and comforted in her old age by a multitude of lusty descendants.

One must not be too critical or too severe. "Wassermann morning" must be very trying; and a succession of organisms "morphologically identical with K.L.B." (whatever that may mean) surely merits an occasional rest in the arms of Calliope.

Perhaps, some day, one of our eminent pathologists will settle down in Ooty on retired pay and become the Bard of the Blue Mountains.

Before leaving Ooty one must say something about the Todas—the remnant of the aboriginal inhabitants of this district. The origin of these people seems to go back to a dim and distant past, and is still hidden in the mists of conjecture. In physique, ethnology, archæology, culture and language the Todas are isolated and unique. They appear to have no affinities with any other Indian race. They are a peaceful, pastoral people to whom the buffalo is Life—spiritual as well as material; in fact, the buffalo is to them what money used to be to us. They are handsome in a wild, uncouth way; and they have many strange manners and customs, including the practice of polyandry. As a rule they are quite friendly and full of fun, and a visit to one of their bigger villages is an amusing and interesting experience. The entertainment will include part-singing, and for the small sum of one rupee you will get more verses than there are words in the Song of Solomon.

What is the secret of the survival of the Todas, and of their unruffled contentment and happiness in a world plagued with poverty, discontent and strife?

The answer is: the cow.

Why, then, should we not follow the example of this primitive race, and substitute the cow for the sovereign or sterling—or whatever is supposed to govern our destinies?

It seems to have been proven beyond doubt that the sovereign, etc., are utterly useless and subversive, whereas we know well that the cow is full of good deeds and altogether beneficent.

Suppose, for instance, that we had to pay America another instalment of the War Debt. This might take the form of a million Highland cattle, two million Ayrshires, three million red Herefords, four million Devon shorthorns and five million Jerseys—say, fifteen million in all.

In order to replace this mighty herd, we should all have to go back to the land, work hard and—in consequence—gain everlasting happiness. Those of us who could be spared would be engaged in building ships to transport the animals and, on the day the armada sailed, we might be able again to sing, "Britannia Rules the Waves," without feeling shamefaced about it.

By this form of payment the U.S.A. also would solve her unemployment problem. Half a million new cowboys would be enrolled for byre-conservancy duty. All the corn in the great Middle West would be consumed to keep the fat stock in condition, and all the cotton in the Southern States would be woven into *jhools* to keep the beasts warm in the winter time. The builders would be busy, for all the bank premises would have to be altered and enlarged to accommodate current accounts (steaks, joints, ox-tails, etc.), savings bank accounts (salted butter and cheese) and deposit accounts (tinned cream and maconochie).

The negro problem would be solved likewise. All the surplus negroes would be mustered as cattle-men for the Atlantic passage; and arrangements would be made with the British Government for the disposal of all such personnel found to be in possession of saxophones, banjoleles or jazz music. On a ship's arrival at Southampton, Liverpool or Glasgow, the heads of all incriminated negroes would be tapped smartly with heavy sledge-hammers, after which the offenders could be converted into fertilizers for the purpose of forcing the grass necessary for the oncoming herds.

Further, India and America would discover a bond of union in the sacred cow and the golden calf. No doubt Mr. Gandhi would embrace us on both cheeks, and obtain advantageous terms, for the export of billions of India's noble remnant—with a safeguard against canning, of course. This would immediately clear up the Indian tangle, and endear us to our American cousins as never before. The gift of a handsome pedigree cow will infallibly melt the heart of the hardest American—not excepting Mr. Hearst or the chairman of the foreign relations committee.

There is no end to the heavenly possibilities of such a scheme; people would be so busy milking cows and dodging bulls, that they would have no time for fighting or for attending any more conferences; in fact, we should have attained the long-looked-for Millennium.

On June 1, we bade Ooty a reluctant farewell and made for Mysore, 100 miles away, by the northern road.

The first part of the route, over the rolling downs of the Nilgiri plateau, is good going. Then there is an abrupt descent, very steep in parts, with sharp corners and a bad surface. The hillside is densely wooded, but here and there you can obtain a wonderful view of the plain below. Next come the foothills, through which runs the Mysore State boundary. This zone is also covered with forest, largely composed of tall clumps of bamboo. It is stocked with game, including wild elephant. Finally there is a stretch of uninteresting plain, over which the car bumps and rocks as the objective, Chamundi Hill, is gradually approached.

The State is dotted with a large number of huge, isolated, rocky outcrops, some of them towering to 5,000 feet; and, as their summits often afford a good water supply, many of them were, in the old days, crowned by strong fortresses.

Chamundi Hill is situated two miles south-east of the city, and is 3,500 feet high. Chamundi is another name for Kali, the consort of Siva. The summit of the hill may be reached by a flight of steps but, thank goodness, there is also a fine, modern motor road to the top. Here there is a temple to Kali, and a pretty little summer-house where, in the hot weather, the maharajah sometimes rests in the cool of the evening.

The colossal figure of Mandi, Siva's bull, is worth seeing. It is a finely executed sculpture, hewn out of the solid rock: date, about 1675. The bull is in the recumbent attitude and, even so, is sixteen feet high.

These curious rocky outcrops are natural, but another prominent feature of the Mysore landscape is artificial—the water. All over the country you come across lakes or " tanks " which are often so extensive that it is hard to believe that they are man-made. One of them, Sulekere, is forty miles in circumference. They are usually in series, and are part and parcel of the irrigation system.

Mysore State was originally inhabited by wild, aboriginal tribes. Their descendants are still to be met with in the remoter parts of the country. Following these primitives came Buddhists, Jains, Brahmins, Mussalmans and Christians. From this it will be readily understood that Mysore has had a lively history.

With the fall of the old capital, Seringapatam, in 1799, Mysore's long life of storm and stress ended, and a period of lean years culminated in the classic famine of 1876-78, the result of failure of four successive monsoons. This was a terrible visitation. Thousands upon thousands of countryfolk crowded into Bangalore in hopeless confusion and despair. They died in the streets, of starvation, at the rate of forty a day. Government poured grain into Bangalore, but there was neither a scheme, nor any means, of distribution. At first sight this may seem to be a glaring piece of ineptitude, but is it not an example, on a small scale, of what is happening throughont the world to-day ?

In 1881 the British Government founded the system of administration which is now in force and, since then, the State has made such rapid and sound progress that it is by far the most advanced of all the native States, and much more advanced than many parts of British India.

The common tongue is Kanarese. Café's Telegu, Noir's Tamil and our Urdu were useless here.

Mysore (i.e., "Buffalo Town") City is a worthy place. It is well planned, with broad streets, fine buildings, artistic monuments, beautiful gardens, an efficient police force and a conservancy establishment which really does a job of work. *Actually, the city is clean* !

The maharajah's palace is rather tawdry and flimsy, but it is of secondary importance to the palace in Bangalore. It contains the famous coronation chair, presented by Auranzeb in 1699.

The diwan's house was built originally by Wellington (then Colonel Wellesley) for his own use.

To see Mysore City in all its glory, you should arrange to visit it during the Dusehra festival. This festival is to Mysore what the Wagner celebration is to Bayreuth, or Shakespeare's birthday is to Stratford-on-Avon. However, Mysore always seems to be *en carnival* ; from the city, the illuminated Chamundi looks beautiful ; and to view the lights of the city from the hill is to catch a glimpse of fairyland.

The loveliness and variety of much of the scenery in Mysore is due to the fact that the State occupies the southern angle of the east and west

Ghâts, where they converge and commingle in the Nilgiri plateau. In addition to this, a ridge, which runs north and south, forms the dividing watershed of two great rivers, the Kistna (or Krishna) and the Cauvery.

From Mysore our route followed the line of the western Ghâts. It presented a wondrous succession of wild hills, rich valleys, swiftly flowing streams and thick forests of tropical luxuriance. As far north as Belgaum we travelled by the lesser roads to the west of the main highways. As a result we had to pay a goodly sum in tolls to the Mysore road fund (*sic*) but it was well worth it; the long drive through these magnificent jungles left an impression which neither Georgina nor I will ever forget. And here, alas, I fail! I'm sorry about this but—not being a W. H. Hudson—description is impossible.

Ten miles north-east of Mysore is Seringapatam. It is approached through a crowded bazaar. Here Georgina stopped the car and created a diversion by soundly spanking a small boy who was tormenting a tethered fowl. The bystanders—including the offender's mamma—were too astonished to protest. Clear of the bazaar, we crossed a bridge, and were then on the island of Seringapatam, in the Cauvery River. The island is three miles long by one broad, and contains the fort, an ancient temple dedicated to Ranganatha—a big and imposing building—the Gumbaz or mausoleum of Haidar Ali and Tipu Sultan, and the summer garden and palace where Colonel Wellesley resided.

To see Seringapatam properly, you should arrange to halt for three or four hours.

We made straight for the dâk bungalow—a clean little place, carefully sited on a grassy patch overlooking the river and facing the Wellesley bridge. The butler, a Mussalman, said he knew all the sights. So he did: at least, he knew their locations, but he was utterly ignorant of their names, uses or history. The result was that, when he said: "Stop, Your Honour," we had to consult the map and then fend for ourselves. Georgina intoned a chant from the guide-book while I gazed wildly around, trying to identify the dungeon in which the British were kept, in chains, for years and years: the exact spot where Tipu met his doom: the durbar site, and the harem where Haidar emulated Blue Beard.

There is no worse method of sight-seeing. According to the Georginian chant, Seringapatam became the capital of Mysore in 1610. Although between 1638 and 1771 it sustained eight sieges, it never fell to the enemy: he was either beaten off or bought off.

Haidar Ali and Tipu Sultan, foreseeing trouble with the British, extended and strengthened the fort. Nevertheless, when we first besieged the place, in 1792, we gave Tipu such a bad time that he submitted to terms. Thereafter, further strengthening was carried out so that, on being besieged a second time (1799) Tipu put up a stout and prolonged resistance.

Eventually the fortress was carried by storm in a very gallant manner, and Tipu fell in the closing stage of the assault.

Contrary to the opinion of many people to-day, the Great War was not the only war: there were a few brave men in days of old.

The ramparts of the fort are very fine. They should be viewed first from the main bastion, near the breach made in 1799. This vantage point will give you some idea of the courage and determination of the attacking troops, who had to cross the broad river under heavy fire before actually engaging in the assault.

While I was trying to visualize Georgina's intonation—"Cheering madly, the foremost troops made for the breach"—Sri Purshottamnadas Venkatachalaiyam (hereinafter referred to as "S.P.V.") joined our little party. Obviously he was a Hindu. All the same, he lifted his cap. He said: "Good morning, sir and madam. Do you require a guide?"

"Good morning. We hate guides."

"Sir and madam, your present conductor—though doubtless a worthy man—knows nothing. I, Sri Purshottamnadas Venkatachalaiyam, am university student, and quite aware of all historical facts of my native land."

We fled, closely followed by Café, Noir and the D.B. butler. We scrambled into the car and hurried off to the picturesque watergate, near where it is said Tipu met his end. However, before Georgina had finished her chant about this sector, S.P.V.—who had borrowed a cycle—tracked us down.

"Good morning, sir and madam. Do you require a guide?"

Again we beat a speedy retreat. This time we covered from three or four miles at top speed. We saw the old bungalows once inhabited by the surgeon and by the director of ordnance to the Mysore *raj*. These officials were Englishmen, and their bungalows—fully furnished—and gardens are still kept as they were a hundred and more years ago. These places are full of interest and, like everything else in Seringapatam, are in excellent condition. By reason of this, the Mysore administration merits our grateful thanks.

In spite of furious pedalling, S.P.V. just failed to catch us.

However, on reaching the Darya Daulat—the summer garden and palace—S.P.V., who had taken a short cut, received us at the entrance.

S.P.V. was a youth about twenty. He had a pleasant face, a good manner and spoke English well. His clothes, though decidedly threadbare, were neat and clean. He told us all about the frescoes on the wall-coloured panoramas depicting Colonel Baillie's defeat in 1780, Haidar's triumph and Tipu's procession, etc.

We soon found that S.P.V. was as good as his word in so far as his country's history was concerned. He knew what to tell us and how to tell it; and when we had "done" the place thoroughly we felt sorry we had avoided his acquaintance earlier in the day.

"And now, S.P.V., we must go. By the way—is this your regular occupation?"

"Oh, no, sir! I am a fourth-year medical student, at present on holiday. But times are hard. I shall be grateful, sir and madam, if you can spare me a rupee."

The Mysore medical student does not seem to be very different from his prototype in other parts of the world—in one respect, at any rate.

In Mysore, Medicine is now a close preserve. Pursuant to the prevailing nationalistic sentiment, the state medical school was moved from Bangalore to the capital; and, as a M.B.(Mysore) is not allowed to practise in England, so it has been decreed that a F.R.C.S.(Eng.) shall not be allowed to practise in Mysore. This is called Reciprocity on the Self-Determination model. If the shade of Mr. Woodrow Wilson ever looks down on our wonderful world, it must find it difficult to believe the evidence of its own eyes.

From Seringapatam we struck north-west over the hills to Shimoga, a rough drive of 150 miles. There are good rest-houses at Hassan, Arsikere and Shimoga. You can cut out Hassan by driving direct from Channarayapatna to Arsikere over a road—a very bad one—which is not shown on the map.

Leaving Shimoga on the morning of June 4, we reached the Gersoppa Falls in time for tiffin.

We first visited these Falls early in December, and that is the time to see them at their best. Before the monsoon there is too little water to make a spectacle, and during and after the monsoon the view is entirely obscured by dense clouds of mist and spray which rise from the depths of the ravine. Besides, during the latter period the river is so swollen and turbulent that the ferry-boat from the north—or British—side is unable to cross to the south, or Mysore side; and, to realize the full beauty of these falls, you must view them from both banks. The south bank is unapproachable except by this ferry.

The Falls are 18 miles east of Gersoppa village. We have mis-named them, and perpetuated the mistake on our maps. The local and correct name is Jog Falls. They are situated on the Sharavati River, 30 miles from the sea. The water drops down a sheer cliff in four cascades—the Rajah (or Horseshoe), the Roarer, the Rocket and La Dame Blanche.

At this point the river is 230 feet in breadth, and the drop is 830 feet.

Compare this with Niagara: Horseshoe Fall, breadth 2,600 feet and height 155 feet; American Fall, breadth 1,400 feet and height 165 feet.

The volume of water which pours over Niagara is much greater than in the case of the Gersoppa or Jog Falls; but nothing can surpass the effects of the latter's tremendous height and unspoiled beauty. In these respects it can have few—if any—rivals in the world.

There are a number of well-situated vantage points at various levels on

both banks. If you wish a minor thrill, you should scramble down the south bank and, from the bottom of the chasm, look upwards. If you desire a major thrill, you may lie on a narrow, projecting ledge of rock high up on on the north bank, wriggle forward—your ankles firmly grasped by your relatives, friends and servants—and look straight down into the depths of the boiling cauldron 850 feet below—that is, if you can.

That is what Hell must look like: terrifying but beautiful, horrible but magnetic.

After this, a certain amount of bravado concealed the fact that I had a ghastly sinking feeling in the epigastrium—but I wanted to have another look. Georgina said: "No. My turn." Well, it wasn't my fault. Her inspection lasted about $\frac{1}{100}$ of a second. She gave a quick gasp, wriggled back like an electrified lizard, lost her colour, told me off for a foolhardy knave and marched us off the rock.

In the early afternoon a lovely rainbow forms across the foot of the falls and, as the sun gradually declines, the rainbow slowly mounts until it spans the top of the falls—an entrancing sight. At times, the moon, too, throws a faintly tinted light across the belt of spray.

On great occasions—when the Heaven-born visit the place—Bengal lights, burning straw, charred wood and similar articles are floated over the falls. The cascades and clouds of spray are thus lighted up in a way which produces an amazingly weird effect.

In the dâk bungalow on the British side there is a visitors' book full of interesting names and entries. Many of the latter are early Victorian and, if somewhat heavy, are of a high literary standard. It would be difficult to find a more inspiring natural sight than the Jog Falls.

Next day we arrived in Karwar after a grand forest drive, via Sirsi and Yellapur, of about 125 miles.

Karwar is the north-west district of North Kanara. The port is the only safe haven on this coast between Bombay and Cochin. At one time it promised to be of importance on account of a projected extension of the railway from Hubli. The extension did not materialize, and now Karwar is merely a small coasting and fishing place and a resort for holiday-makers who spend all their time—sleep and meals excepted—in the sea.

One day, Charles—the Charles who packed the butter into our thermos—was neither eating nor sleeping; that is to say, he was bathing.

He is a peaceful, inoffensive person.

Imagine his alarm and surprise when a minnow suddenly darted at him.

Charles side-paddled.

The minnow missed, sulked for a moment, and then made a second and more determined attack on its quarry.

This time Charles spread-eagled his legs, and the minnow just failed to butt him on the right patella.

Charles is like most quiet men when roused; he has a temper which

effervesces *pari passu* with delay. As the minnow flashed past, Charles grabbed it by the tail. Unfortunately, the little brute whipped round and bit him on the shoulder.

Charles let go.

The rest of the story I had from Mrs. Charles. It is best told in an expurgated form.

It seems that Charles thought that a white-hot spear had been thrust through his deltoid.

He said so.

The whole arm became intensely painful, swollen and red, and Charles said things about that too. Then, poor chap, he became too ill to talk much; but he made up for this later on, during convalescence.

The acute stage lasted for two or three days, during which the limb became completely paralysed. It was not until about the tenth day that Charles really felt himself again.

On the assumption that the minnow must have died of shock, Charles bathed on the eleventh day. He carried with him a pickle fork, but, I am glad to say, had no occasion to use it.

Inquiries amongst the local fishermen, at the headquarters of the Bombay Natural History Society and elsewhere, failed to clear up the mystery, and this so preyed on Charles's mind that he resolutely refused to send an account of the incident to the press. I suggested that the CORPS NEWS AND GAZETTE would be glad to publish a short description of the affair, but the suggestion was received with quite unwarrantable asperity.

Personally, I think that Charles must have bumped one of the "Emden's" derelict torpedoes. That ship spent some time in the Indian Ocean before delivering the famous bombardment of Madras. Charles avers the thing was no bigger than a sardine; but then, if there is one thing Charles hates more than another, it is exaggeration.

Karwar harbour covers the seaward expansion of the estuary of the Kalinadi River. Its mouth is protected by the picturesque Oyster Rocks. A few miles to the south of this barrier lies the Portuguese island of Anjidiv. Across the water, to the north, may be seen the tree-clad hills of Goa. The whole scene is delightful.

This, however, is New Karwar. Old Karwar—now in ruins and scarcely discernible—was a different place. It was a noted centre of trade, intrigue and strife, and its history provides many illustrations of the difficulties and dangers which faced the traders and seamen of old. Here, in 1660, Sir William Courten's Company started a muslin weaving factory which, for a time, proved a great success. As the venture prospered and grew, a valuable export trade in muslins, pepper, cardamoms and cassia was established. Sivaji started the trouble, but was bought off for what was then a large sum: Rs. 1,120. Of course, the germ of blackmail spread to all the local chiefs and freebooters, with the result that, although the

factory continued to show profits, conditions were more or less precarious during the ensuing forty years.

In 1684 the factory was the centre of a serious disturbance, when the crew of a small vessel landed, carried off a cow, and killed the animal.

Troubles arising from Portuguese enmity and Dutch jealousy were constant. Then the Marathas built a fort in the vicinity, and so threatened the factory that it had to close down from 1720 to 1750. It then reopened for two years, but was finally put out of action by the Portuguese in 1752.

We stayed at Karwar for a few days, and then made for Poona via Yellapur, Haliyal, Khanapur and Belgaum—a run of about 320 miles, which we did in two stages.

On arrival in Poona I found a letter awaiting me. The postmark was "Jullundur." The missive ran thus :—

"Protector of the Poor—Salaam !

Over a long time your servant has not been praying for your Honour's return to Punjab. Likewise my wife and two children—both males, praise be to God—have not been praying for your Honour's and Memsahib's daily arrivals.

Your Highnesses—Salaam !

God Almighty—to whom all thanks are overdue—at last answers united fervent prayers now arranging your Honour's transfer to Punjab, thus your old servant's heart is full to bursting of high tensions.

Send wire at once. Also fare to Poona, where your slave may attend to conduct your Honourable Bahadur and Memsahib to Punjab, via B.B. and C.I. Rail-gharri.

Sing to the ALL-POWERFUL (from whom all blessings are overdue) for that your Honour's return to the care of this unworthy chap.

Send fare, also advance of pay and *rassad*—URGENT.

Ever praying for your long lifes and prosperities,

Your old servant,

NABBHI BAKSH (Bearer)."

Aha, the Hop again !

I have neither information nor orders.

And yet, this is not the first time the Hop has startled me with the same sort of letter.

We shall see. Coming events cast their shadows before ; and when the shadow takes the form of a shrewd little Punjabi Mussalman, it would be unwise to treat it with contempt.

A return to the north ?

Ah, well, no matter! At any rate, we have been DOWN SOUTH.

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Aha, the Hop again!

I have neither information nor orders.

And yet, this is not the first time the Hop has startled me with the same sort of letter.

We shall see. Coming events cast their shadows before; and when the shadow takes the form of a shrewd little Punjabi Mussalman, it would be unwise to treat it with contempt.

A return to the north?

Ah, well, no matter! At any rate, we have been DOWN SOUTH.

Editorial.

THE CHEMISTRY OF FLESH FOODS AND THEIR LOSSES ON COOKING.

In the past ten years scientific research on foods has been mainly devoted to the subject of vitamins, and the old view that a diet is a question of proteins, fats, carbohydrates and calories has received little attention.

The earliest comprehensive food tables were compiled by König in 1882, from his own and other people's analyses; proteins, fats, carbohydrates, total ash and water were given. Seventeen years later the well-known tables of American foods prepared by Attwater and Bryant appeared; in these measurements of the inedible portion were given. In the next fifteen years little was done in this country. Following on the outbreak of war in 1914, the War Office was gradually faced with the problem of preparing diet tables for millions of men. It was then realized how few analyses of English foods existed, and Professor R. H. A. Plimmer was asked to make a complete analysis of the common British foods. Determinations of refuse were made and edible portions analyzed for proteins, fats and carbohydrates. The total ash was determined and the chlorides were returned as sodium chloride. This was the first time that an inorganic element had been included in a systematic food analysis. Plimmer pointed out that "the proper basis of the food value of meat should be of the lean. This part of the meat is eaten by all people, and it suffers very little loss during cooking. The amount of fat in meat is diminished during cooking and, further, individual taste may discard the whole or part of the fat. The fat content is thus indeterminable for the individual, and it is not possible to give a figure for the energy value of meat as eaten. A minimum calorie value is that of the lean." Plimmer, therefore, analysed the lean and the fat separately.

Following on the recognition of rickets as a deficiency disease, analyses of calcium and phosphorus began to be made; and a study of the anæmias caused interest in the determination of iron.

The most recent food tables in Germany have been made by Schall, and where the information is available he has included figures for potassium, sodium, calcium, magnesium, phosphorus, iron, sulphur and chlorine.

All the analyses made hitherto have been of uncooked food, in which form most of it is never eaten; also, the loss on cooking has not been determined, so that for the construction of individual dietaries the tables now available have been considered unsatisfactory. With the object of obtaining more exact information on the composition of cooked foods, the Medical Research Council made grants to Dr. R. A. McCance for systematic analyses of food as it is actually eaten, and the figures he has obtained

therefore apply mainly to cooked material. He has also studied the cause and the extent of the various losses brought about by cooking.

In the analytical procedure each joint of meat or piece of fish was weighed before and after being cooked. The edible portion was then removed and the waste or the edible portion weighed. In the case of fish there was no difficulty, but with meat a very real difficulty arose in dealing with the fat. Gross fluctuations in fat content were found to be an important cause of variation in the nitrogen and salt content of meat. Fat and lean, therefore, were analysed separately.

The Report on McCance's work just issued by the Medical Research Council contains full information on the procedure adopted for the determination of total nitrogen, non-protein nitrogen, purine nitrogen, carbohydrate, fat, total phosphorus, chlorides, sodium, potassium, calcium and magnesium. The analytical methods used for gravies and drippings were the same as those employed for meat.

In the tables showing the composition of cooked foods the method of cooking is given, and also what has been included for the edible portion. In stating the analytical results the amounts of the various organic constituents have been expressed as grammes, and those of the inorganic constituents as milligrammes, per 100 grammes of edible matter. Two factors (F_1 and F_2) are also given. By multiplying the given figures by F_1 the quantities which can be obtained from 100 grammes of the food as served can be ascertained. Similarly, multiplying by F_2 gives the amounts from 100 grammes of the raw food.

As an example: an analysis of beef sirloin with bone, roasted and underdone in the centre, gave 26·8 grammes of protein per 100 grammes, and F_1 is recorded as 0·80 and F_2 as 0·64. Therefore, $26·8 \times 0·80$ gives the protein in the meat as served, viz., 21·44 grammes per 100 grammes of beef, and $26·8 \times 0·64$ indicates the protein in the meat before cooking, viz., 17·15 grammes per 100 grammes of the raw food.

The figures for F_1 and F_2 vary with the food and the method of cooking. In stewed steak F_1 is given as 1·00 and F_2 as 0·57; for grilled mutton chops F_1 is 0·49 and F_2 0·31.

These elaborate tables will no doubt be very useful to the physician who is making out a dietary for a particular case of disease, but for the calculation of the food required by a body of soldiers we prefer to use the tables given by Plimmer. In McCance's tables there are no figures for calories, and these would have to be calculated, as we still require the diet to furnish a certain number of calories and to contain a certain amount of first-class protein. Plimmer gives the calorie value per 100 grammes, per ounce, and per pound.

McCance gives very full information about fish, and in one of his tables (A) an attempt is made to include all the fish usually eaten in this country. Each fish has been given its full zoological name as well as its popular name. Some of the fish may be unfamiliar to most

people. The table shows that there is no connection between the popularity of a fish and its value as an article of diet. The lesser-known gadoids, such as the torsk and saithe, have practically the same composition as the cod and haddock, and the megrim and witch are just as nutritious as the Dover sole and much cheaper. McCance draws attention to the variations in composition of foodstuffs, and as cooking introduces another variable published figures can only be average values of variable quantities. He considers the dangerous errors in working with food tables are : firstly, the systematic analytical ones, and secondly, the use of inappropriate tables, for example, the use of tables showing raw composition when the food is actually eaten cooked.

A comparison of fried and steamed fish gives some idea of the effects of different methods of cooking. Enormous quantities of fried fish are eaten every day in this country. The pieces of fish are usually rolled in batter or egg and breadcrumbs before being cooked. Fried fish is an article of diet very different in some respects from steamed fish. Fried fish contains about 14 per cent. less water and 3·2 per cent. less protein, which is counterbalanced by a gain of 10·5 per cent. of fat and 6·4 per cent. of carbohydrate. These changes result in an enormous increase in the calorie value, which is nearly doubled by the frying.

With regard to the determination of protein McCance disapproves of the practice of multiplying the total nitrogen by 6·25. He says total nitrogen is not all protein nitrogen, and 6·25 is not the correct factor. He thinks it would be much better if everyone would give up the use of the factor altogether and work only on the nitrogen figures. In his tables the protein figure is obtained by subtracting the extractive nitrogen from the total nitrogen and multiplying the difference by 6·25. This has been done to make the tables more acceptable to the majority of people interested in food problems.

Plimmer states that the figure 6·25 is nearly correct for the proteins of the muscular tissue of animals, birds, and fishes, as their proteins contain approximately 16 per cent of nitrogen. The protein of milk contains only 15·67 per cent of nitrogen and he therefore used the factor 6·38 for the proteins of milk. For the proteins of vegetable origin he employed the factor 6·38.

Fish have not been found to contain less purines than meat—smelts and herrings are very rich in purine nitrogen ; sprats and sardines contain even more and whitebait is only surpassed by soft roes and sweetbreads. Soft roes, which are a mass of nuclei without reserve protein, contain more purine than anything else examined.

The percentage of soluble salts in meat and fish is not greatly changed by cooking. Boiling may lower it a little and roasting and frying raise it, but on the whole the results may be expected to be of the same order as those obtained on raw materials by Kratz, Sherman, Grey and others.

Sodium is found to vary from 50 to 120 milligrammes per 100 grammes

of cooked material. The figures for potassium ranged from 200 to 400 milligrammes per 100 grammes. Most of the wide variations in the potassium figures are readily explained by the methods of cooking. The lowered values after prolonged boiling or stewing are examples.

Calcium has received more attention than either sodium or potassium. The present analyses have confirmed the low values for mutton, beef and meats generally; the higher and variable values for fish are probably due to the inclusion of small bones in the edible portion. Sardines and whitebait are a valuable source of calcium as their bones are small and therefore often eaten.

Very few determinations of magnesium have been made hitherto. McCance found the percentage is not much changed by boiling and stewing; 100 grammes of fish or meat contained 25-35 milligrammes. The low concentration in eggs and roe tissue is noteworthy and undoubtedly has some physiological significance. The winkle was found to contain between 300 and 400 milligrammes per 100 grammes.

Iron in meat was found to range between 4 and 10 milligrammes per 100 grammes. Sardines, smelts, sprats and whitebait contained 0·5 to 1 milligramme per 100 grammes. Some of the marine invertebrates contained very large amounts of iron.

It is interesting to note that a very high phosphorus content may be caused either by the inclusion of bones with the edible portion, or by a very high proportion of nuclear material, as in soft roes, sweetbreads and livers. Low results are generally due to prolonged boiling.

The losses brought about by cooking have been carefully studied by McCance. This subject is of great interest to caterers, for upon it depends how far a joint will "go," and it is with this aspect of the problem that he has been especially concerned. No attempt has been made to include palatability in his investigations, since research along these lines has recently been started in the United States.

Grindley and his associates have studied the cooking of meat, and their researches lend no support to Liebig's, or the "pellicle," theory of cooking. According to the pellicle theory, cooking of meat should begin at a high temperature. This coagulates the proteins on the outside of the meat, and an impermeable skin is formed, which retains the water, salts and protein in the meat. When, on the other hand, a strong gravy or soup is required, cooking should be commenced in cold water and the temperature gradually raised. This allows the soluble constituents to soak out before the proteins on the outside coagulate.

The pellicle theory has received recognition from many scientific men and a little scientific support from Vogel. It is stated definitely in most cookery books.

Grindley found "that the loss from the meat, represented by the ingredients in the broth, was really no greater when the meat was placed in cold water than when placed in boiling water."

McCance states that a skin of coagulated albumin cannot act as a membrane in the physiological sense, for semi-permeable membranes of protoplasmic origin generally, if not always, lose all their properties when heated. Further, a joint will require to be cooked for some hours and would then shrink to about sixty per cent of its original weight. The distortion of the surface of such a shrinking mass would destroy any impermeable skin that might have been formed. He showed that the small loss of salts in frying and roasting is the result of evaporation. Also, when cooking is carried out in water the loss of salts and other crystalline bodies is the same whatever the initial temperature. The application of heat over 60° C. to fish and flesh foods, leads to the shrinkage of their proteins and the expression of juices. This is the only cause of salt loss when meat is heated in steam or air, and an important cause of loss at all times. When meat is heated in water, some salts are lost by diffusion into the surrounding water.

McCance has found no evidence that a pellicle forms on the outside of a joint when cooking commences at a high temperature. There seems no reason why an oven should be raised to a high temperature before the joint is inserted, or why the water should be boiling before the meat is put in. Both would appear to be a waste of heat. He regards the popular belief that underdone meat is more nutritious than over-cooked meat as probably psychological in origin, and due to the rich red colour of the unchanged hæmoglobin compounds in underdone beef, for, however it is cooked, meat has been shown to be completely digested, and to lose little, if any, of its nutritive properties. He has obtained no evidence to support the popular belief that underdone meat is preferable. Since the greater part of the weight lost by cooking is water, it is obvious that, pound for pound, over-cooked meat must contain more protein and probably more fat than underdone, and be, therefore, a more concentrated food.

McCance admits that the practical cook may criticize his work by saying that in cooking meat juices are not lost, but made into gravy which is consumed. This is correct as regards meat, but is not true of fish liquors which are generally discarded.

It might also be said that if the losses of salts and extractives were important they would have been recognized long ago. This criticism can only be met by a careful study of the metabolism of calcium, phosphorus, potassium, etc., over a sufficiently representative section of the community; but this work lay beyond the scope of the present study.

Clinical and other Notes.

A MODIFIED CASE FOR HORROCKS' BOX FOR PACK TRANSPORT.

By Major W. W. S. SHARPE,
Royal Army Medical Corps.

The following modifications in the Case Water Testing Sterilization suggested themselves during a two-day water reconnaissance, when it was necessary to test the water supply of camping grounds situated every ten to fifteen miles. The case is fitted with a double frame, which is extended and fixed with a wire stirrup to support it, and into this the black cup and five white cups are inserted. Smaller sockets are made to take the stock bottle of cadmium iodide and starch indicator and the drop

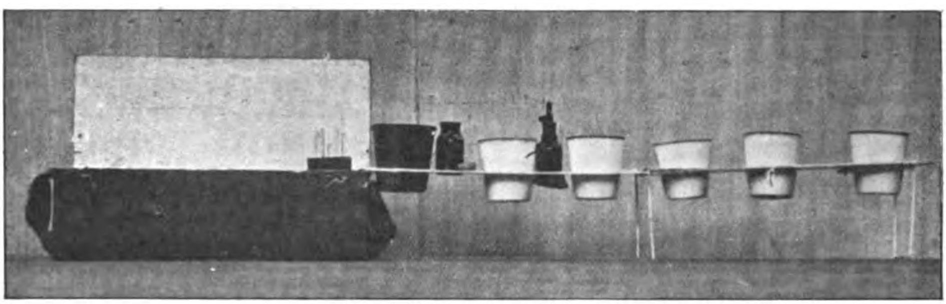


Fig. 1.—Case opened out ready for use.

bottle. The pipettes and stirring rods are placed conveniently to hand in a vertical position when the box is open and the case is ready for use.

The sixth cup is filled with water and remains in the box as a control, no indicator being added.

When the box is closed, the cups are kept in position by wooden rings, over which they fit when inverted, and are kept from rattling about by the frame sockets fitting over them.

The stock bottle and dropping bottle fit into sockets, which can also be used to take the containers for sodium thiosulphate and acid sodium bisulphate. The stand for pipettes and glass rods is now fitted horizontally in its wire bracket.

It will be seen that the whole apparatus is carried packed in such a way that the risk of leakage and damage is reduced to a minimum. When required for use it can be rapidly opened out and placed in any convenient situation, on uneven ground, river-bank, lakeside, etc., and the test easily carried out with everything to hand, and without the necessity of looking for a level place on which to stand the cups.

The cups cannot get mixed up; they are all held level, and the indicator in its socket in the frame is safe from being knocked over, an annoying accident to occur miles from a laboratory. A long narrow stock bottle is shown in the diagram.

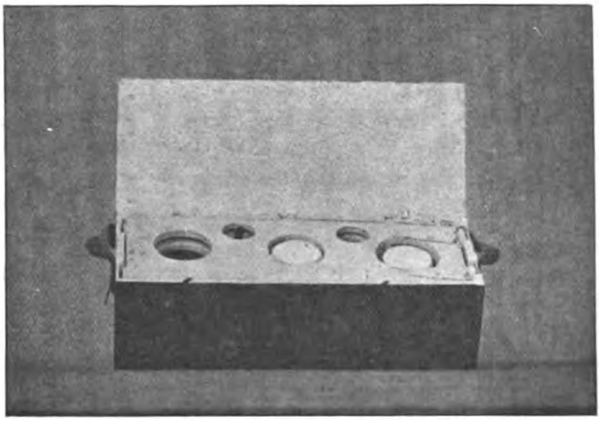


FIG. 2.—Case closed, showing frame keeping cups and bottles in position.

The cost of materials is about 4s. 6d., and the increase in size and weight, without the tablets, over the present case is as follows:—

	Size	Weight
Present case	$9\frac{1}{2}$ in. × 5 in. × 4 in.	2 lb. 14 oz.
Modified case	15 in. × 6 in × $4\frac{1}{2}$ in.	5 lb. 3 oz. complete

DISPOSAL OF LITTER IN RAZMAK, WAZIRISTAN.

By LIEUTENANT-COLONEL W. A. M. JACK, *O.B.E.*,
Indian Medical Service,

AND

ASSISTANT SURGEON L. W. ROSE,
Indian Medical Department.

RAZMAK is a perimeter camp at an altitude of 6,500 feet in the centre of Waziristan. The camp is situated on a plateau which slopes at a gradient of about 1 in 20 to a deep nullah.

In the summer the maximum temperature does not reach 90° F., with an almost daily rainfall; in the winter there are frequent falls of snow.

Litter from 2,700 horses and mules, 550 cattle and 700 goats and sheep has to be disposed of, amounting to 110 Army transport cart-loads, approximately 20 tons daily.

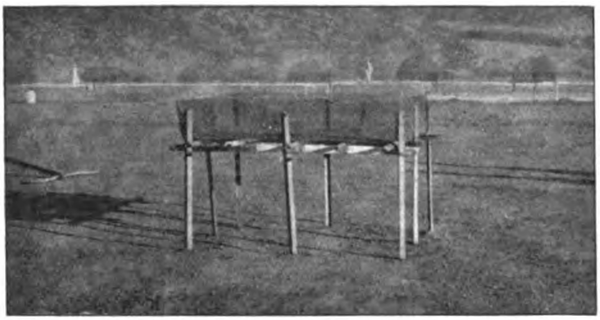
Owing to climatic conditions the disposal of this litter is not easy. No assistance is received from the local inhabitants, who are unwilling to remove it for agricultural purposes.

In the past each unit was responsible for the disposal of its own litter. A site about 400 yards by 100 yards (8 acres) was required for the purpose. This area was far too large to permit of adequate cleanliness being maintained. The incinerators, improvised from whatever materials were available, were of every shape, size and type. There was little system of drainage, so that rain-water from units' areas flooded those of other units. This was found most unsatisfactory. Control over no less than 31 different areas was almost impossible. Excessive fly-breeding was inevitable in spite of every care.

With a view to improving this state of affairs, the scheme outlined below was evolved :—

(*a*) *Control.*—The burning of litter was centralized and carried out by the Conservancy Establishment, under the direct control of an Assistant Surgeon.

(*b*) *Site.*—A fresh site, as level as possible, was selected. This was marked out into three areas 70 feet by 220 feet, the length being across the



Basket incinerator.

slope of the ground, and carefully graded to permit rain-water to drain off effectively, but yet not at such a rate as to erode the ground. Each area was rolled by a heavy roller to consolidate it and the surface plastered with clay.

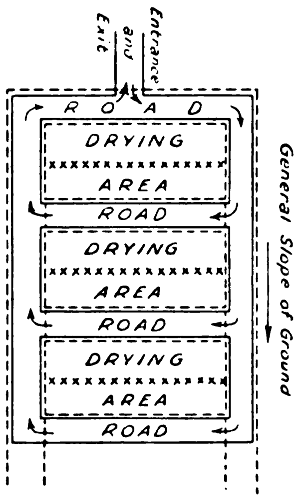
(*c*) *Roads.*—Roads 18 feet wide were made round each area.

(*d*) *Drainage.*—Each area and each road was provided with drains so that no rain-water washed across other than that which actually fell upon it. Bridges were provided wherever necessary.

(*e*) *Incinerators.*—A type of incinerator was made as follows : Eight angle irons 6 feet long are driven vertically 2 feet into the ground in the form of a rectangle 6 feet by 4 feet, one angle iron being at each corner and one in the centre of each side. Three feet from the ground two 7-foot angle irons are bound with wire horizontally to the longer side of the rectangle, and five 5-foot angle irons laid at right angles horizontally across these at even distances, being bound with wire to them and, where next the uprights, to these also. The whole thus forms a frame to receive a basket. This

basket is made from a sheet of expanded metal (mesh 1 inch by 1 inch) 8 feet by 6 feet, of which the corners are suitably cut and the sides folded to form a tray 6 feet by 4 feet by 1 foot deep, the corners being bound with wire. The basket thus accurately fits into the frame. A row of thirteen of these incinerators, each 10 feet apart, is placed down the centre of each drying area.

(*f*) *Lay-out.*—The whole area is laid out as shown in the sketch below.



Drains are indicated by dotted lines, incinerators by crosses.

(*g*) *Organization.*—All litter is brought by units' carts twice daily at specified times. A superintendent is present to direct them and to indicate where they are to dump their litter. All carts take the general circular course indicated by arrows in the diagram above, thus avoiding confusion and delay.

The carts first arriving proceed to the side of the area farthest from the entrance, depositing their litter in order till that side is covered; carts subsequently arriving proceed to the near side of that area, till that also is covered.

Each drying area is similarly brought into use in rotation.

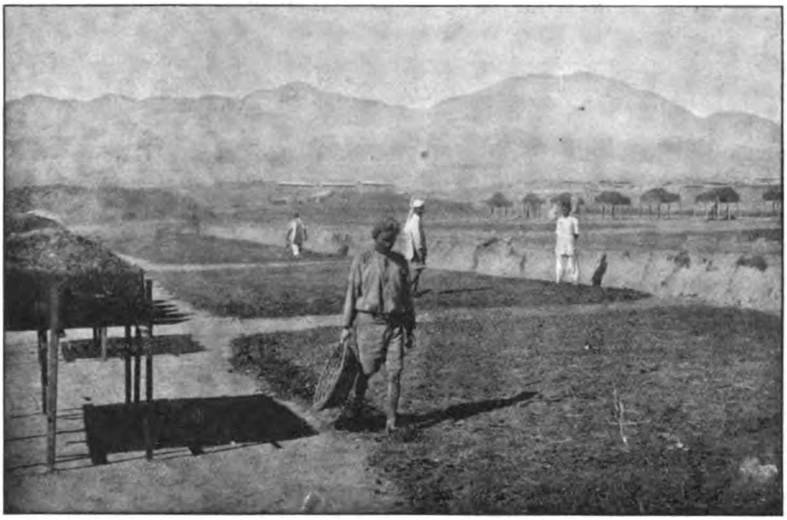
The attendants spread the litter out to dry immediately it is deposited by each cart, thus ensuring that the next cart dumps in a suitable spot and that the distribution is even.

When depositing litter, the rear of the cart is backed to the drying area so that litter can be shot directly into the area. On no account are carts allowed to leave the road to go upon the drying area.

The litter is spread thinly and burnt on the incinerators as soon as dry enough. When the area is cleared, it and the surrounding drains are at once carefully swept and the sweepings burnt. The area is then left

vacant till again required. All areas are used equally, so that each has in turn an opportunity of being referred to the sun and repaired.

The incinerators are raked thoroughly four times a day, and all ash falling through is immediately swept from underneath, collected on one side, and removed in a special cart twice daily.



Drying area.

The results of the above system of incineration are as follows :—

(*a*) The daily 20 tons of litter are now disposed of effectively each day. (Opportunity of doing so in snow has not yet arisen, but difficulty is not anticipated.)

(*b*) The area to keep clean and to prevent fly-breeding is reduced from 8 acres to 1 acre.

(*c*) The personnel employed on litter-burning duties is reduced from 63 fighting men to 21 conservancy sweepers.

(*d*) The whole area is scrupulously clean.

We gratefully acknowledge the valuable assistance and suggestions of Lieutenant F. G. Wintle, R.A., Station Staff Officer, Razmak.

Travel.

BEYOND LEH.

A SHOOTING TRIP IN LADAKH, 1926.

Being a Diary kept by

K. W. DICKSON, F.R.G.S.

(*Continued from p.* 150.)

XVIII.—Back in Leh.

It was a wonderful morning; I woke early and watched the day break.

The socks were so far down I had to sit and darn for an hour before breakfast, which we had outside as the tents were packed up before we were ready.

Shushot is a succession of villages with a large grazing meadow on the south side of the river. If aeroplanes go to Leh, and it becomes fashionable, which God forbid! the landing place and golf course will certainly be at Shushot.

We passed these little villages with their groves of poplar and willow. Larks were singing overhead, the grass smelt so sweet. I felt if I had shut my eyes it might have been the links at Gullane on an April morning with the Lammermoors instead of the Himalayas in the distance.

Shushot seemed by far the most prosperous place we had passed through for a long time. Large double-storied houses with carved shutters, although no glass in their window frames, stood each in its own poplar grove. There were far more animals, sheep, goats, ponies and cattle, than further up the river.

For the first time I felt tired on a morning march, but the day before had been a long and rather disappointing one. I began to ride sooner than usual. We passed several encampments of nomads. Their camps were obviously placed where grass and water were plentiful for the animals, rather than where there was shelter for themselves. These people, "Changpas," have tents made of goats hair woven in dark stripes, and there is always a flag at the top. Rubchu, Mrs. Kunick told me, is where they come from. The number of ponies and goats on this grazing ground was very surprising. I don't know how they are kept alive through the long winter, as there is so little ground for grazing even in summer.

We rested under the willows at the far side of the bridge. It was a delightful spot, especially on such a morning, and we lay and watched the minnows in the river. Garry and Kelpie lay and slept and looked so harmless that eight or ten baby goats came and fed beside them. We had to keep Garry under our eye in case of trouble.

There was a long tiring road ahead of us; an ascent of over a thousand feet over deep sand, with the hot June sun above us. Leh is much higher than the Indus, although only a few miles from it. We took turns on the riding pony, and decided to stop for a meal where there was a breeze, probably in a gap between the hills. However, we found it too hot even there to sit for long. The reflection from the rocks and sand scorched our faces. One of the baggage ponies, a tiny grey mare with a foal trotting by her side, was far behind and seemed hardly able to go on even at our slow pace, so we called to Subhana to have the baggage changed from her to my sturdy riding pony. We found the poor little mare had a very ugly sore on her back, so we made the man shoulder the saddle, and she followed slowly with the foal.

The road was very hot underfoot so Kelpie thought he would try the top of the biggest Mani wall in Ladakh. He got up at a broken part of the wall, but at the other end, about a quarter of a mile further on, the wall was so high that we had great difficulty in getting him down.

My pony man had deposited his load at the Dak Bungalow and came back to meet me with the pony. I was very glad to see him. I passed Khansamah, tired and going wearily along, and tried to make him get on my pony, but he would not; if the sahib could walk, then he could do so too.

I had had a letter from Mrs. Kunick at Ugu asking us to come in for a meal at whatever time of day we arrived, so we took her at her word and went in. Her servant had told her he had seen her saddle on a pony outside the post office where we had stopped to collect our mail, so she had got a few minutes' notice of our arrival.

The postmaster said there was still no other European lady in Leh, and that he had never heard of a lady arriving in Leh so early in the season.

How we appreciated sitting down to tea in a house with a table cloth and china cups after two months of camp life, and Mrs. Kunick made it so much a home that we were not at all strange. She insisted upon us dining with them that night, and I knew our cook would be glad of a rest. She apologized for a vegetarian dinner, but that happened to be just what we were prepared to enjoy as we had had no fresh vegetables up Chuma-tang way, and here we got new spinach and good potatoes, also yeast bread which we had not tasted since we left Srinagar.

We were amused at the dogs when we got into the lane which led both to the mission house and the Dak Bungalow; they remembered the bungalow and made for it at a gallop, so we were not troubled with them at the Padre's house.

The Padre told us that the surveying party which was going to explore the source of the Yarkund River had encamped in the Residency grounds. He said Major Mason was in charge, so I knew it was the expedition I had heard about in Simla. That evening as I was giving out stores just before the light went, I heard a voice say, "Is that you, Mrs. Dickson?" I looked

up and saw Major Minchinton. Men do look very different with beards, but I managed to recognize him. We used to know him in Lahore, and we had met again in Corstorphan's Hotel in Simla last September. I saw him last one evening in Calcutta when we went to Firpos after dinner. I didn't know until then that he was on this expedition. He was the expert mountaineer of the party. He brought Major Clifford, the doctor of the expedition, to see us; and Major Mason came round later; we had played tennis with him in Simla.

I got out a map and Major Mason showed us where they intended to go, and what they intended to do, or rather hoped to do. They were waiting to get over the Khardung Pass which was not yet open, as it was a particularly late season. A week later they hoped men would be able to cross without loads to break the track, but it would be difficult even for yaks. The weather was cloudy with very little frost at night, and the snow was soft all the way up. Report had it that there was a drift near the top that yaks would not be able to cross.

Beyond the Khardung the party were to continue on the Yarkund road, turning west at a point before the country where the source of the Yarkund River was supposed to be. A great valley lies to the north-east of K2 which had never been explored, and that was the work before them.

We talked about Simla, and he asked about our journey, where we had been, the condition of the Zoji La when we crossed, and we got so interested in details (even to parasites and the best way of dealing with them) that when R. looked at his watch he found it was a quarter past seven, and we were dining with the Kunicks at 7 o'clock.

Next day R. went to the Moravian Hospital to see if there were any eye cases. I supervised a big washing, and then darned socks for three hours. Later I found that the women in the mission knit socks throughout the winter, and I bought eight pairs so as to make sure we would not run short. They were made of white homespun wool, very soft and cosy, and formed a good pad inside our chapplies.

Major Mason came to ask us to go over to the Residency garden to see their kit that afternoon. We went to sleep and arrived an hour later than we intended at their camp. It was intensely interesting seeing all the special tents, sleeping bags, etc., presented to the expedition by the Royal Geographical Society. The tents were green, made of strong yet light and firm material. They weighed only 56 pounds, and have a floor of the same material all in one piece, so that the wind would not trouble them as it troubled us up the Chuma-tang Poo. The sleeping bags were quite different from what I had expected to see. I had imagined sheepskin bags, but these were made of eider-down, lined with soft brown woollen material, and covered with fine waterproofed cotton; they were green like the tents; they tied at the top, and up the side opening had the new patent metal fastener which so far I had only seen on tobacco pouches and purses. They weighed practically nothing and could be aired and disinfected quite easily, whereas sheepskins are heavy and insanitary.

We also saw the new Swiss surveying apparatus which was to be used for the first time on this expedition. It had a high-power small telescope and a camera side by side on the same stand. This stand had at least four spirit levels so as to be perfectly accurate. The camera was made of aluminium and had plate-glass plates, and a yellow screen for snow. A smaller telescope had glass scales attached, with prisms to reflect light on the scales. Photographs are taken up to a hundred yards apart to exaggerate the stereoscopic effect; these are put in a stereoscope, and a sister instrument projects the contours, so distinctly shown, on to a flat plan or map. Such an instrument is almost beyond the understanding of an ordinary person like me, but it was most interesting to hear about it. Its

FIG. 22.—Ladakhis in Leh. A Mohommedan shopkeeper.

case was even a marvel to me. The camera box had a protective lining of sponge rubber more than an inch thick. From our own experience of transport we knew how necessary this was.

We found the stores most interesting, too. There were thirty-six boxes made of three-ply wood from the Army and Navy Stores, London. One box in four had a padlock and hinge, so that it could be kept for the stores in current use. Each of these cases was specially planned to feed four men for five days, and contained an allowance of everything from sugar, tinned fruit, biscuits, to tobacco and sweets. Boxes labelled A1 contained no tinned milk, meat or tinned vegetables, as chicken, mutton, milk, eggs, etc., could be obtained *en route*. Number A2 contained a change of food from A1, but the same type. The boxes marked B were calculated to be suitable in a high altitude, and so on. I must say they all looked well on the feeding.

Later we saw some photographs taken with this camera of the hills round Leh, as they wanted to test the camera. They had a canvas boat which was also tested on the pond in front of the Dak Bungalow. This was the pond which was frozen the morning after we first arrived in Leh.

Major Mason was O.C. of the expedition, and was to do the actual surveying and photography. Minchinton was the climber and was to collect birds and butterflies; Clifford, the doctor and botanist; and Cave saw to stores, servants and transport, and was responsible for mineralogy.

After leaving the Residency grounds we paid a visit to the only shop in Leh where European stores are kept. One expects stores to be expensive in such a place, but the prices even exceeded my expectations. Coffee was four shillings a pound, and as it could be obtained by post for two shillings and sixpence a pound, I did not buy much. We saw a very pretty Yarkundi whip and put it among our stores, as we thought it might help Garry to keep on his best behaviour.

On Sunday R. was off before sunrise, as he had heard that sharpu had been seen in a nullah to the north-west. I was besieged with vendors selling every possible kind of Tibetan souvenir, from prayer wheels and lama bells to homespun woollen goat bags. I got some spoons, a flint and steel, such as they all wear attached to their cummerbunds, two of the ordinary cups that a Ladakhi carries in his bosom, and a china cup in a copper bowl with a lid. I had watched my pony man drinking from the little wooden bowls by the roadside, but the better class carried these copper bowls with a little Chinese cup inside.

While I was examining the goat bags, a new sahib, Captain Emery, walked into the compound, bearded and brown. I sent to ask if he would have a cup of coffee, as neither his baggage nor his lunch basket had arrived. He told me where he had been shooting, and I saw his heads later. Two ovis ammon, three burrhel, and three antelope. The burrhel were not nearly so good as R.'s heads, but I admired the antelope; they were so very pretty, so light and graceful. The ammon looked very massive. He had had two shooting blocks; a burrhel and ammon one south of the Pangong lake, and the antelope block was further north, over the Chang La, a pass which is over 18,000 feet. It was a very lonely district, and for eight days he had seen no one, and had passed no human habitation. They had to carry fuel as there were no trees, not even burtsa, the shrub that we had used up the Chuma-tang Poo. The cold had been intense crossing the pass, and his servants had been afraid as they heard a story about a sahib's bearer dying of cold on the pass the previous year.

That evening I went for a walk with Mr. and Mrs. Kunick to a very bigoted village to see a large chorten and a prayer wheel which is turned round by a water wheel. "Merit" does not seem to be of much value when it is so easily acquired. This village was studded with chortens; they were even built into the houses. A man in this village is hereditary Prime Minister of Ladakh, and is a knowledgeable person. At that time he was

directing the transport of the survey party over the Kardung pass, and I heard it said that if anyone knew the conditions, he did. But he was a bigoted Buddhist. Quite recently he gave an order that all the children attending the Mission Sunday School were to visit a certain monastery on Sunday afternoons, so that it was impossible for them to attend the mission. Mission work in Leh must be in many ways a disheartening occupation. It seemed to me that what they needed most of all were one or two practical industrial workers who would stay at least a year in Leh, and teach such industries as cloth and rug weaving, carpentering, tailoring and sewing. Boys educated by the mission have been sent again and again to Srinagar to learn these industries and so become teachers, but none have ever returned to help. They have been out of touch with the missionaries, their heads have been turned before they had any stability of character, and when other posts have been offered at a better salary than the mission could offer, they did not hesitate to break their contract. If a school of instruction could be started in Leh itself, the outlook would be entirely different.

R. returned about 6.30, having been out on the hills for twelve hours. He had seen a herd of sharpu, but not a ram of any size among them. Next day he went out again, this time to the east of Leh, but had no better luck, so he decided to take tents out the following day, and go further afield above Sobu village. It was a busy day, as he did seven or eight operations at the mission hospital that morning before lunch, which we usually had at 11.30. I got our large lunch basket filled with cooked food, enough to last him three or four days. Mrs. Kunick had supplied us with bread regularly, which was a great treat.

While R. was away I went down to the Mission House for most of my meals, but having the dogs, I slept in my own tent in the Dak Bungalow compound, and had breakfast on the lawn about 7.30. Garry and Kelpie had a most gory fight that morning over a disreputable looking lady dog who seemed to live in the compound. Garry got his teeth into Kelpie's ear, and the blood poured down. Our tall strong shikari went hurriedly to the other end of the garden and busied himself with a roll of bedding. I had Garry by the tail, but wanted someone to hold Kelpie. I called loudly for the whip and at last got it, and it came in useful for Garry. I gave orders for the lady dog who was the cause of the fight to be taken away.

One day when I was in the Bazaar with Mrs. Kunick, I saw fifty or sixty coolies standing in front of the Tehsildar's office. I heard them protesting against being forced to go up the pass, asking who would look after the wives and families if they died in the snow. When the Deputy Tehsildar asked if they could not cut a way through the snow, they called back with one accord, "No, it is impossible." Mrs. Kunick translated what they said.

On Thursday morning before breakfast (R. was still up at Sobu) I got out the big telescope and got it set on the Khardung pass, and felt quite thrilled to see a long line of coolies going up right to the very top it seemed. However, by the time I had finished breakfast I saw the long line coming

down again, and thought that another attempt to get over the pass had failed. I was longing to hear what really happened, and took the first opportunity to ask Major Mason when I met him at a tamasha given by the Khan Bahadur that afternoon. He said they had not tried to cross, but had dumped all their stores at the top of the pass. He and Minchinton had been up that morning and had gone down the other side for a quarter mile, treading out a path for yaks and ponies. They were all very cheery and hoped to get away in two days when he had his accounts cleared. Later when we were watching a game at polo, Major Mason got a telegram from the Wazir saying he had no authority to force the coolies over the pass if they were unwilling to go, as the pass was not "open," so his difficulties did not seem to be over.

However, on Saturday, two days later, the Tehsildar himself (the man we had met on his outward tour at Chuma-tang), came over the pass from the other side from the Shyok river, and went to the Residency to ask why they had not gone over. There were no difficulties about it after that. They had a late lunch on Saturday, packed up, and went to Paulo, at the foot of the pass for the night, nine miles from Leh. Next morning from half past seven I watched a long line of coolies, yaks, and ponies, like a string of ants creeping up the snow. I arranged the telescope on a heap of stones and let Mrs. Kunick watch them too.

XIX.—A Party in Leh.

The Khan Bahadur, Ghulam Mohammed, who gave the party, is a fine old pensioner who has served for thirty-five years, many of those years at Gilgit. He is now revenue officer for hemp coming over the pass from Yarkund. He came along one evening and asked us if we would go to his house to tea one day; a little dancing first, then a polo match after tea, he said. We watched the dancing for quite an hour. Several Ladakhi dances, a man from Gilgit, then a Yarkundi. It ended up with a Ladakhi doing a very slow dance with scarves. It was all interesting, but I was glad when the drums and whistles stopped and we went indoors for tea. I sat between Major Mason and a Pathan, a Khansahib, from Peshawar, who was one of the mountaineering experts of the expedition. After tea the Khan Bahadur asked Mrs. Kunick if she and I would go in and talk to his wife and daughters. To my surprise I had to act as interpreter, as Mrs. Kunick does not talk Hindustani. I almost made a *faux pas*. I began to ask if the very small children were grandchildren, as the parents looked much more like grandparents. There were about five grown-up young women and four tiny children. They proudly showed us a new addition to their house. It was crowded even now, according to our ideas for such a family. There was a large bedroom in which were five large single beds. In this room about eight people slept, and all the cooking was done on a stove in the middle of the room. The girls asked if I sewed, and wanted to see some of

my sewing. I didn't say I had spent most of my leisure in darning socks lately!

After talking to the Indian ladies for half an hour we went to watch the polo on the long sandy ground behind the English store shop. The Khan Bahadur's side played the team of the English stores manager; he had a Yarkundi trader in his team, who had two fine Yarkundi ponies with black silky coats. The Khan Bahadur rode a grey Zanskar pony. The trader played left-handed, a most dangerous thing to allow. There were several narrow escapes, but no accidents. After a goal is scored, one of the team canters down the field with the ball in the palm of his right hand, the stick being held in the same hand. Then he throws the ball up, hitting it towards the goal as it falls. One man was very clever at this, almost scoring a goal from the original hit, and never failing to hit the ball with his stick. There were a few real polo sticks in the teams, but the Ladakhis used ordinary sticks with a half crook at the end. Major Gompertz (Ganpat). the author of "Harilek," was among the guests that afternoon. He had just arrived and was camping alongside the surveying party in the Residency grounds.

I walked home with Mrs. Kunick; she could tell me so much about the people and about Leh, and told it in such an interesting way that I was always very glad of her company. She told me that in 1919 a heavy shower of rain fell in and around Leh. It didn't last more than half an hour, but the result was that an avalanche of mud descended from a glacier in the hills above, obliterating miles of cultivated fields, and the main street of the bazaar is now two or three feet higher than formerly. Before the avalanche the shops stood a few feet above the ground and now they are on the ground level. Fields are still being reclaimed that were buried in 1919.

R. had returned on the morning of the party, having had no better luck. He was tired with so much trekking and rested the following day, while I went down to help Mrs. Kunick with a little tailoring job she had begun, and in the afternoon we went on a shopping expedition. First to the house of a wealthy trader from Yarkund to look at silks and stone marten skins. We had seen the trader himself playing polo, but as he is a Mussulman, his wife does not go out, but she gave us a great welcome in her room. She was a fine looking woman, spotlessly clean, and made me think of a portrait of an English lady in the sixties. She had black hair smoothly brushed, worn in two pigtails down her back. On her head was a small dark blue skull cap, finely embroidered in grey silk thread. She wore trousers which only showed at the ankles. A short tight-fitting black satin jacket covered her blouse, and a full silk skirt covered most of the trousers. She had a fine face, of the type that a portrait painter would love to paint. When we came into her room two little boys were lying sleeping at the far end on a padded quilt with a long circular cushion under their heads. The cushion was covered with gay Yarkhundi silk, and the children were covered with an English travelling rug. These people love getting English goods. I saw

an eider-down sleeping bag, just like those that had beeu supplied to the survey party, in the room where the furs were hung. It would have cost £7 to buy in London.

The lady pressed us to have tea, but we assured her we had just finished tea, so she went for a plate of almonds, sultanas and dried rose hips, and set them before us. I bought some China silk and then went to look at the furs. The stone martens were not so good as we get in Lahore, and were the same price. I looked at the snow leopards; they were beautiful, but I do not like them for personal wear. The fox were all of the yellow variety. I described the fox we had seen at Ugu to Mohammed Bahud Din, and he said it was probably worth four hundred rupees, about £30. The pointed fox are very uncommon even here.

We went back to the bungalow to hear if R. had got any "khubar" (news) as to the whereabouts of sharpu. Four men had been out and two had now come back having seen a herd to the north-west of Leh, near where R. had been before, so he made arrangements to go off at four on Sunday morning.

On Saturday morning there was an influx of visitors to the Dak Bungalow. While we were eating our tiffin on the lawn a lady and gentleman rode in on good Kashmiri ponies, followed by a lot of servants, some riding, and many pack ponies. This was Donna Edwige Toeplitz, an Italian lady, wife of the director of a large Italian bank and Mussolini's financial adviser, and a Mr. Stuparitz, the manager of the Lloyd Trestino in Bombay, who was accompanying her. Mr. Stuparitz had a very kindly Scot's west country accent. They went into the bungalow and did not use tents.

Not long afterwards Mr. Newman, a young subaltern, arrived. He, too, like Captain Henry, was on his way back from a shikar trip. R. asked him to come and have a cup of coffee, but he would not come until his beard was removed. I heard him asking for a barber. He had been on the Frontier for three years, and the only woman he had spoken to during that time was the wife of his Commanding Officer, who had once gone up on a visit. He told Mrs. Kunick when he dined with them that she was the first lady he had spoken to since the summer before. We considered that the Dak Bungalow was quite crowded now, but while I was having tea, a single lady came, wearing khaki riding breeches and coat. She rode up to the bungalow as if looking for someone, and I thought she was probably a friend of Donna Toeplitz; then she went away. Thinking she was probably very tired, I ran after her and asked her if she would have some tea with us, but she said in broken English that she was looking for a place to pitch her tents. She told me afterwards that she was a French artist and had been some time in India painting, and had come up there to make sketches. Her name was Mdlle. Lafugie. I thought her extraordinarily plucky to go so far all on her own, and she had gone to monasteries and made quick sketches of the lamas.

Just as we finished dinner at 8 o'clock that evening another party arrived. Two ladies with a little Ladakhi servant girl. One was a nursing sister from a Zenana Mission in Kashmir, and the other was a friend who had come out from a big school in Ireland to see India. They pitched their tents on a grassy part of the compound where we had been having meals. There was really no other place, but it meant that even when I was resting I had to keep the flap of the tent down, or the servants would see right inside.

R. was away before dawn next day, and I stayed in the compound nearly all day doing some very necessary mending and re-soling leather socks. These roads would wear the pads off an elephant!

We dined with the Kunicks that night, and Mr. Peter, the other Moravian Missionary, was there, too. We discovered the possibility of going over to Stok on the other side of the river. I was very anxious to meet the hereditary King and Queen of Ladakh, who are now Rajah and Rani of Stok since the conquest of Ladakh by the Dogras, and R. was keen to try an open nullah on the far side of the river for sharpu, as he had not even seen a good head among the herds in the Leh nullahs.

(To be continued.)

Current Literature.

WEIGL, RUDOLPH. **Faits d'Observation et Expériences démontrant l'Efficacité du Vaccin à Rickettsia pour la Prévention du Typhus.** *Archives de l'Institut Pasteur de Tunis.* 1933, xxii, 315.

The vaccine used is obtained by anal inoculation of typhus virus into lice, the intestines of which are collected after eight days and a carbolized suspension is then prepared. Three injections at seven days' interval are given, the *Rickettsiæ* contained in the intestines of 120 to 170 lice being required.

The vaccine has been employed for the last three years in Poland, in French North Africa, and in Belgian Catholic Missions in China.

In Poland over 6,000 people have been vaccinated. In 1931-2, 2,755 individuals received three injections; they were doctors, hospital employees, and persons who had been in contact with typhus patients. Among these there was only one case of the disease, and that was a doubtful one.

The author states that during the course of vaccination of contacts about 0·5 per cent developed the disease in from a few days to fourteen days. These individuals were in the incubation stage of the disease when vaccination was begun, and in them the disease was mild or of an abortive type. He considers that vaccination is not inadvisable during epidemics. But, as the result of guinea-pig experiments in his laboratories, he considers it

desirable that individuals suspected of being in the incubation stage of the disease should receive an inoculation of convalescent serum before being given the vaccine.

In the Belgian missions in China, 200 persons were vaccinated during two years and no protected individual contracted the disease, although one non-protected missionary died of typhus; the disease was rampant in the neighbourhood of the missions. Before inoculation was introduced, typhus was common amongst the personnel of the missions and accounted for 83 per cent of the deaths.

Laboratory experiments have given decisive proof of the efficacy of vaccination against typhus. This was first demonstrated by C. H. Nicolle and H. Sparrow, who immunized an infant by giving three injections of vaccine at one to two months interval, and then tested for immunity by inoculating virus contained in the brains of infected guinea-pigs; the child remained unaffected, while control guinea-pigs contracted the disease.

Three experiments on man were made in the author's institute, the first being made without his knowledge. The subject of the first experiment was the wife of a laboratory assistant, and she, along with the laboratory personnel, had been vaccinated against typhus in 1930.

Her husband, who had suffered from typhus, was employed in nourishing infected lice; he had great faith in the efficacy of anti-typhus vaccination, and his wife must have had great faith in him, for in October, 1931, she allowed several hundreds of the infected lice in his charge to feed on her. This went on for several days until the writer discovered what was being done and stopped the experiment. The woman did not develop typhus and, at her own request, she again began nourishing infected lice and has done so regularly since then. Four non-vaccinated workers in the laboratory were accidentally infected by these lice.

Two other workers in the laboratory, Mme. H. and M. C., repeated the experiment; they were vaccinated early in 1933 and began nourishing infected lice, one one month and the other three months after the completion of the inoculations, and since then several thousands of lice have fed on them daily.

M. H., husband of Mme. H., had never suffered from typhus and had not been inoculated against the disease; he was employed in the laboratory in nourishing uninfected lice. One day he visited his wife in the room where she nourished infected lice and he became infected with typhus, probably from lice excreta. When he began to feel ill, and not knowing what was wrong with him, he gave his healthy lice to a colleague, M. B., to nourish. The latter had neither been vaccinated nor had suffered from typhus. After two days the lice were examined and *Rickettsiæ* were found in them. The author at once began inoculating M. B. with typhus vaccine, three injections being given at intervals of two days. On the fourteenth day after the infecting bites, M. B. developed typhus, with a rash. He gave a positive Weil-Felix reaction and lice *Rickettsiæ* were agglutinated by

a 1 : 640 dilution of his serum, but the attack lasted only twelve days and convalescence was rapid. Healthy lice fed on M. B. did not show *Rickettsiæ* and emulsions of them inoculated into guinea-pigs were non-infective, also blood taken from M. B. at three periods of his illness did not infect guinea-pigs.

On the other hand, M. H., who must have received a comparatively small amount of infecting material, transmitted the disease to 100 per cent of lice fed on him.

The author considers that the vaccine administered to M. B., although unable to prevent the disease, established a relative immunity, and that antibodies prevented virus from spreading in the circulation, although it continued to develop in the tissues. Experiments were then made on guinea-pigs, and they confirmed this assumption, for guinea-pigs, vaccinated immediately before or after inoculation of typhus virus, became infected after a prolonged incubation period with either a febrile or an indefinite form of the disease, but the virus did not appear in their blood, although the brains and supra-renal capules of these animals were infective to lice and guinea-pigs.

LAWRENCE, G. P. **The Use of Autogyros in the Evacuation of Wounded.** *The Military Surgeon*, 1933, lxxiii, 314.

Experiments have been made by the United States Army Air Corps, and others, in the transportation of sick and wounded by air. Special airplane ambulances and ambulance planes extemporized from transport machines are part of the equipment of all U.S. army flying fields. These machines require larger landing grounds than are usually found near the firing line or even within the division area.

The writer considers that autogyros would be ideal for ambulance work and gives a description of their structure and capabilities.

A point of great value is that in still air an autogyro can take off with a run of 240 feet, while with a breeze of twenty miles per hour a run of only 100 feet is required, and with a thirty-five mile per hour wind the machine can rise almost vertically. The autogyro can climb about 100 feet in a minute, that is about twice as fast as a bomber, and as it can rise at twice as steep an angle as does an ordinary aeroplane, it can get up from a very small field. In can land in a space twice its own length. It can maintain altitude at a speed of twenty-four miles per hour, and against a wind of thirty miles per hour or more it can hover or fly backwards. A recent model has no fixed wings or rudder,' and is even more stable and easier to control than the earlier models.

A manufacturer has designed an autogyro ambulance to carry a pilot, one sitting case and two cases in American Navy wire basket type Stokes stretchers. This machine is said to be easier to load than a motor ambulance wagon. It has a cruising speed of over 100 miles per hour, can hover, can descend perpendicularly, and can take off at a steep angle with a very

short run. The writer considers that such a machine could remove wounded from collecting stations chosen by collecting companies trained in reconnaissance for ambulance gyros and in signalling to them. Flight could be made direct to a general hospital in from fifteen to thirty minutes, obviating transfer of patients to the division hospital and evacuating hospital, thus saving two ambulance rides and a rail journey. The work of the division hospital would then be mainly concerned with the lightly wounded who could be retained till fit. The ambulance battalions and evacuation hospitals would have much less work than at present and fewer would be required.

Working on an estimate of ten per cent of casualties for a day, giving for a brigade a total of 382 requiring transport, the writer calculates that it would take thirty-eight hours to bring them to the evacuation hospital by present methods, while four autogyro ambulance planes could evacuate them to a general hospital fifty miles away in about thirty-one hours.

Autogyros could often go further forward than ambulance wagons, and they could "potter around" in the dark guided by the collecting company using electric flash lights.

Cavalry wounded could be collected by autogyro much more easily than by the present medical squadron.

The author considers that as evacuation is an army responsibility and not usually a corps function, aerial ambulances should be organized as an army ambulance wing similar to the Bombardment Wing.

Reviews.

RECENT PROGRESS IN MEDICINE AND SURGERY, 1919-1933. By various authors. Edited by Sir John Collie, C.M.G., M.D., D.L., J.P. With a foreword by Lord Horder of Ashford, K.C.V.O., M.D., F.R.C.P. London: H. K. Lewis & Co., Ltd. 1933. Pp. xii. + 368, 33 illustrations, including 12 plates (4 coloured). Demy 8vo. Price 16s.

Sir John Collie and his collaborators tackled an enormous task in summarizing medical progress in the last fifteen years in a volume of 353 pages, and they have produced a very serviceable work.

Some of the twenty-one chapters are of great interest to the surgeon, especially those on surgical tuberculosis, radiology, manipulative surgery, plastic surgery, anæsthesia, and the two very valuable articles on orthopædic surgery and on urology, by H. A. T. Fairbank and J. Swift Joly respectively. In the pages allotted to the eye Sir William Duke-Elder gives a brief, but clear outline of the use of the slit lamp, and the modern outlook on intra-ocular infections and glaucoma are amongst the subjects considered.

The chapters dealing with advances in medicine are concise and up-to-

date. Those dealing with diabetes, by R. D. Lawrence, and with endocrinology, by Langdon Browne, are the models of clearness we expect from such authorities.

The tropical section, by Sir Leonard Rogers, is necessarily much compressed, but it covers most of the field of advance in this branch of medicine.

Dr. Bernard Schlesinger contributes a valuable chapter on rheumatism.

Professor de Wesselow deals with biochemical methods from the point of view of the general practitioner. The sections on blood-sugar and blood-urea will be found of the greatest value as the author discusses the significance of these bodies and the value of their estimations.

The authors are to be congratulated on having produced a most useful work, which can be recommended to officers of our Corps as it gives them in a few pages the gist of many scattered articles, a great boon to those stationed far from medical libraries.

ANNALS OF THE PICKETT-THOMSON RESEARCH LABORATORY, Vol. viii. THE COMMON COLD. By D. and R. Thomson. London: Baillière, Tindall & Cox. 1932. Pp. xxiv. + 738. 51 plates. Price £3 3s.

In compiling this large volume the authors state that they have extracted information from no less than 2,000 research papers. Their own extensive work on the subject entitles them to criticize freely all this mass of literature and they do so with great skill. The work is divided into forty-eight chapters, and there are thirty-nine pages of references. The summary and conclusions at the end of the volume are very interesting reading. The authors consider that it has now been definitely proved that bacteria such as *B.influenzæ, pneumococci, M. catarrhalis,* etc., are the chief primary causes of colds. Colds are not a "single disease" but an infection of the upper respiratory tract by a number of very different species of microbe. They admit the possibility of a filtrable virus being sometimes also a cause, but they are quite definite in their view that bacteria can cause and do cause the majority of colds by themselves alone. They consider that mixed vaccines are of real value in both prevention and treatment. The book is a very valuable work of reference and a mine of information.

A. C. H. G.

MILITARY HISTORY FOR THE STAFF COLLEGE ENTRANCE EXAMINATION. By Captain E. W. Sheppard, O.B.E., M.C. Gale and Polden. Price 6s. 6d.

Although Military History is not required to be studied by officers of the Corps for examination purposes, this book can be cordially recommended to all those who are interested in this subject. The campaigns are dealt with very concisely, and the essential points of interest clearly defined.

L. R.

TROPICAL DISEASES BULLETIN. Vol. 30. Supplement, October, 1933, 238 pp. "Medical and Sanitary Reports from British Colonies, Protectorates and Dependencies for the Year, 1931," summarized by H. Harold Scott, M.D., F.R.C.P., D.P.H., etc., Assistant Director of the Bureau of Hygiene and Tropical Diseases. Price 5s.

In this supplement of 238 pages Dr. H. H. Scott, Assistant Director of the Bureau of Hygiene and Tropical Diseases, has summarized the Medical and Sanitary Reports for the year 1931, from forty-nine Colonies, Protectorates and Dependencies.

This is the third year that such summaries have been issued from the Bureau of Hygiene and Tropical Diseases; the Bureau has done good service in undertaking this most useful work.

The supplement will be of value to all who are interested in health conditions in tropical and sub-tropical countries, and especially to practitioners in these countries, not only because the salient features of each Report are presented in brief, but because many do not as a rule see the complete Reports.

The last seven pages of the Supplement contain a table of the vital statistics of the Colonies, Protectorates and Dependencies extracted from their various Reports.

101 SUGGESTIONS FOR WARD INSTRUCTIONS. By M. K. Barclay, A.R.R.C., Q.A.I.M.N.S. London: Edward O. Beck, Ltd. 1933. Pp. 100. Price 2s. net.

This small book entitled, "101 Suggestions for Ward Instructions," should prove most useful as a guide and help to Sisters in giving daily instruction to nursing orderlies. Each lesson gives a list of the chief points to be enlarged upon by the instructress.

FROM CAIRO TO SIWA ACROSS THE LIBYAN DESERT. By Major T. I. Dun, D.S.O., M.C., R.A.M.C. Published by E. and R. Schindler, Cairo, Egypt. Price 18s. 6d. De luxe volume 26s. 6d. The book may also be obtained from the British Agents, J. Smith and Sons, Glasgow.

In a large handsome volume, profusely illustrated, Major Dun gives an account of an interesting reconnaissance from Cairo to Siwa by the armoured cars of the XIIth Lancers. The author was the medical officer to the regiment. This account is followed by a short history of the customs and the superstitions of the inhabitants of the desert country through which they passed. There are a number of interesting photographs at the end of the book and an excellent map. It is not often that officers of the Corps take on themselves the authorship of books. To most of us such a thing might prove a costly venture into the "unknown." Major Dun and his publishers are to be congratulated on producing what

A Fantasy of the Nile and Cairo.

is a real work of art at a price which makes the book a bargain and will ensure its success. The binding of the book, the paper, the printing and particularly the illustrations are all very pleasing, and a number of well-known artists have helped in its production; the woodcuts of N. Strekalowsky are particularly noticeable. The book should arouse the interest of all who live in Egypt or who visit that country.

Notices.

VITAMIN C.

THERE is evidence to show that the antiscorbutic properties of fresh fruit and vegetables are due to the presence of a substance at one time believed to be "hexuronic acid," but now known to be hexuronic acid less a molecule of water and recently re-named ascorbic acid. The substance has been isolated from oranges, lemons, cabbages and other vegetable sources, and also from the cortex of the suprarenal gland. It has been supplied for research purposes by Messrs. Burroughs Wellcome and Co. for more than a year and is now issued as "Tabloid" Ascorbic Acid 0·005 gramme, each Tabloid being equivalent in vitamin C activity to two teaspoonfuls of freshly expressed orange juice. This is the second pure crystalline vitamin to be issued as a "Tabloid" product, as vitamin D has been issued for some years, first as "Tabloid" Irradiated Ergosterol and now as "Tabloid" Calciferol.

MESSRS. COW & GATE'S MEDICAL BULLETIN.

AN interesting monthly publication is issued by the "Cow & Gate" Medical and Research Laboratories. It contains useful summaries of, and selections from, recent reports and pronouncements on infant feeding questions and dietetic research. Bacteriological investigations of milk supplies and milk production in general are subjects also reported on and discussed at some length.

The Bulletin is a very convenient and well-arranged summary for a doctor who is interested in these questions but has not sufficient time to collect or extract his own material.

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No. 4. April, 1934. Vol. LXII.

Kt. Brit

Journal of the Royal Army Medical Corps

ISSUED MONTHLY

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JOHN BALE, SONS & DANIELSSON, Ltd.
83-91, GREAT TITCHFIELD STREET, LONDON, W.1

Price Two Shillings net

Vol. LXII April, 1934. No. 4.

Journal
of the
Royal Army Medical Corps.

Original Communications.

CYSTICERCOSIS AS SEEN IN THE BRITISH ARMY, WITH SPECIAL REFERENCE TO THE PRODUCTION OF EPILEPSY.[1]

By Colonel W. P. MACARTHUR, M.D., F.R.C.P.(Irel.) K.H.P.[2]
Consulting Physician to the British Army.

The above title was chosen because my experience of cysticercosis has been limited, almost entirely, to soldiers serving or discharged. It is not suggested that the disease is in any way peculiar to members of His Majesty's Army.

Many persons who hear of the investigation which is the subject of this discourse, are curious to know how it came about, so in anticipation of such questions I give an introductory explanation on this point. The inquiry was undertaken to determine, as far as possible, the degree of responsibility of cysticercosis for epilepsy in the Army. On an average, about a hundred soldiers are discharged the Service every year because of epilepsy. Some of these men slipped past the recruiting officers by making a false answer on attestation, and denying that they had ever suffered from fits ; in others,

[1] A paper read before the Royal Society of Tropical Medicine and Hygiene. Reprinted by permission from the *Transactions of the Royal Society of Tropical Medicine and Hygiene*, vol. xxvii, No. 4, January, 1934.

[2] In the writer's opinion, there is nothing new to be said regarding the important literature of cysticercosis. He believes, too, that it would best serve his purpose to give an independent account of the disease as actually studied in the Army. For these reasons the traditional review of the literature of the subject has been expressly omitted. Those interested will find an extensive bibliography in the monographs, "*Le Cysticercus cellulosæ* chez l'Homme et chez les Animaux," Y. Vosgien, 1911; and "Les Cysticercoses du Neuraxe," P. Schmite, 1928.

an inherent epileptic taint became evident only after enlistment. When these two groups, and various oddments, are deducted from the total, there remains a considerable number of men previously healthy and coming of sound nervous stock who developed epilepsy in adult life during or after service abroad. Long before the problem of epilepsy in the Service came within my particular province, I had been much concerned regarding the possible ætiology of this form of the disorder for it could not be attributed to neoplasm, specific disease, or traumatic lesions of the brain. For years past there has been diagnosed in the Army, and sometimes published, an occasional case of cysticercosis complicated by epilepsy. These were regarded by most, including myself, as isolated curiosities of medicine, and their significance as outcrops of an extensive hidden infestation was not appreciated. At one time or another I saw some half-dozen of these earlier cases, and viewing them as a whole it seemed peculiar that they should all have some outstanding sign which could not well escape notice, and which, naturally would lead to investigation. For example, one man had sixty subcutaneous nodules; another almost as many; a third showed a cysticercus in the eye, and so forth. It appeared to me that if these men had presented less obvious signs of cysticercosis, if instead of dozens of palpable nodules, only one or two, or perhaps none, had developed, then the true nature of their malady might not have been suspected. As I expressed it to various colleagues at the time, it was as though we were detecting enteric fever only in those patients who pass a quart of blood per rectum. About six years ago, this belief received striking support. The pathologist to a civil hospital asked for my opinion regarding the nature of some puzzling bodies in the brain of a confirmed epileptic who had died in a fit. According to the history given me then, the man, during the long course of his disease, had been seen by various practitioners of experience, including some with special neurological knowledge, but nothing had been noticed to arouse suspicion that his infirmity was other than some form of textbook epilepsy. On examination of the brain, the bodies in question proved to be cysticerci. This was the most important step in my education for the case linked up the known group of frank cysticercosis, and the presumed obscure or cryptic variety.

Further evidence was collected, here I must mention Lieutenant-Colonel R. Priest's independent work, and by 1929, when it first became my duty to write a part of the Annual Report on the Health of the Army, I felt justified in stressing the close association of epilepsy in the Service and cysticercosis. And finally, eighteen months ago, the War Office issued orders that all men who develop epilepsy in the suggestive circumstances I have mentioned, are to be sent to Millbank for special investigation.

In one way or another, over sixty military cases of proved cysticercosis have been collected, but I do not stress the figure for we know that it is far from complete. There are several figures, however, which I consider most significant; twenty cases of cysticercosis have been diagnosed in Millbank in

the present year, and besides others still under suspicion, eight men who returned from India during the past trooping season have already been proved to suffer from cysticercosis. Of these eight, six were invalided home as ordinary epilepsy, and the other two, though not so diagnosed, had been under medical observation in India because of a history of some kind of seizure.

As everyone knows, there are two tapeworms of which man is the sole host in the adult stage—*Tænia saginata* and *T. solium*; the former passes its cysticercus stage normally in the ox, and the latter in the pig. *T. saginata* is not known to cause human cysticercosis, and if it ever does so, the infestation must be very rare. Whereas the intermediate stage of *T. solium*, given the opportunity, develops rapidly in man, and the embryos have a predilection for the brain, where they select especially the grey matter. I believe that the preference for the eye, especially in textbooks, is only apparent, and is due to the fact that parasitization of the eye, unlike that of other parts of the body, cannot fail to attract attention. In the pig the development of the cysticercus is said to be complete in from three to four months; I presume this refers to its structural maturity, for in man the the parasite may be observed to increase in size for years. Unlike what happens in the case of cœnurus and an echinococcus, each cysticercus includes only one larval scolex; so that a single egg of a *T. solium* of one generation cannot eventually give rise to more than one adult worm of the next generation.

Incubation Period.

The period that may elapse between the invasion of the body and the onset of manifest symptoms is difficult to fix. The main reason is that in the great majority of our cases there is no evidence of infestation with an adult *T. solium* at any time—that is to say, the patient shows no sign of intestinal tæniasis while under prolonged observation, he has not been treated for tapeworm in the past, and denies having ever passed segments. And owing to the greater liability to bowel diseases in the tropics and the consequent watch likely to be kept on the condition of the dejecta, and also owing to the general absence of a water-carriage sewage system, I think that it would be more difficult to overlook a tapeworm infestation abroad than in this country.

In a minority of cases there is a history of *T. solium* to suggest the probable time of infestation. In some of these the symptoms commenced while the patient was actually in hospital undergoing treatment for tapeworm; in others there was a latent period of several years between complete expulsion of a worm and the eventual development of clinical cysticercosis.

Prodromal Symptoms.

In many instances the process of invasion gives rise to little or no general reaction, and so as a rule prodromal symptoms are absent or so mild that their significance is appreciated only long afterwards. Sometimes at about

the probable period of invasion there is a record of admission to hospital for headache and unidentified fever, or for myalgia or rheumatic pains, but these latter are usually of a degree so indefinite as not to impress the patient's memory. Again, there may be a history of temporary localized or diffuse œdematous swelling of those muscles that later are found to harbour cysticerci.

None the less, many men who show advanced infestation of the muscles at the time fits commence declare that they have never had a day's illness, nor missed a game of football or hockey for reasons of health. One man who was a keen pugilist first became aware that something was wrong when a cyst, which had formed on one wrist, interfered with the strings of his boxing glove during a fight. This drew attention to the presence of several other cysts, but he continued to appear in the ring as usual. A year later he had his first epileptic fit.

Established Disease.

If palpable cysts appear, diagnosis is a simple matter, but it must be understood that parasites may invade the body even in large numbers and give no outward or visible sign of their presence. Years later, if they calcify, they may be discovered, perhaps accidentally, by radiological examination.

The number of palpable cysts varies widely in different cases, and also alters in the same patient from time to time. Large cysts that have been under observation for years may vanish completely within a few days, while others appear in sites where previously there was none. Because of this coming and going, patients sometimes imagine that the nodules migrate from place to place. There may be dozens of these palpable cysts or only one; but there is always a larger number in the tissues than show themselves, for when they eventually calcify and become visible in radiographs, more may be seen, say, in one arm than could be palpated at any time in whole body. As a rule, the palpable cysts eventually disappear, with or without accompanying calcification; sometimes, however, calcareous cysts, if sufficiently superficial, remain perceptible as small hard nodules.

The cysts may be detected in the muscles or subcutaneous tissues of any part of the body—the head and face, including the eyelids and lips, trunk and limbs, but rarely in the hands or feet. They are found more commonly in the upper half of the body, not because the parasites are more numerous here, but because of the better cover afforded by the larger masses of muscle in the lower half.

Their size depends mainly on their age and their situation. If in firm tissues which are equally resistant on all sides they tend to be small and rounded, as in the substance of the brain. In the muscles they are oval and lie between the fibres, separating them, and when fully grown may attain a length of twenty millimetres or more. Their size, when palpated

in muscle, usually suggests that of a pea or a hazel nut, but I have encountered examples which in the tissues felt as large as a pigeon's egg.

There is one developmental peculiarity of the cysts which I believe to be of transcendent importance in the pathogenesis of the disease. Its most evident outward expression is seen in the manner in which cysts may continue to appear, singly or in crops, over a long period of time measured in years, while others already in evidence may increase in size in the same way. If we can explain this phenomenon, I think that we solve at the same time the mystery of the extraordinary alterations in the character and extent of the symptoms exhibited by an individual patient at different times, and thus replace a bewildering medley of clinical groups by one intelligible and composite whole. I have found no satisfactory explanation in the literature; if such exists, it is so little known that I make no apology for introducing the matter here. On many occasions men known to have suffered from cysticercosis for several years have shown me one or more cysts which they declared had just recently appeared. But when one of these "new" cysts was examined it always proved to be, not a recent formation, but one of long standing, the contained larva dead and in some stage of degenerative change. All such cysts had one peculiar character in common—the tenseness of the cyst capsule owing to the large amount of contained fluid. Therefore, I thought it reasonable to suppose that the death of the larva was associated in some way with an increase in the quantity of fluid, so that a cyst originally flaccid and not differing appreciably in consistence from the surrounding muscle would be detectable for the first time when it became tense and firm; just as a vein in the arm, previously impalpable, can be felt when it is distended with blood through the application of a tourniquet. There was always the possibility, however, that these men were unwittingly in error, and that some accidental circumstance had merely brought into evidence cysts which they had not noticed before. Recently a case occurred where we are not dependent on the accuracy of the patient's story regarding the late appearance of such cysts. An ex-soldier who has suffered from cysticercosis for seven years was in Millbank in March, 1933. The palpable cysts were counted with great care and their position accurately noted. He was discharged from hospital and kept under observation. In July he was readmitted showing three "new" cysts in situations where none had been apparent before. They felt firm on palpation and had a bulk about that of a hazel nut, but somewhat elongated as is usual in muscle. All three were excised and each was found to be so tense with fluid as to resemble a tightly-inflated Rugby football in miniature. As I had ventured to prophesy before excision, the larvæ were dead and undergoing post-mortem changes, the head and neck being so firmly adherent to the surrounding invagination of the bladder that no degree of digital pressure nor any manipulation could evaginate them, and in the end they had to be dissected out. I think that this confirms my theory regarding the late appearance of cysts in the

tissues.[1] I think, too, that allied changes affecting the intracerebral parasites explain the long delay in the onset of brain symptoms in certain cases of cysticercosis, a latent period that may extend to at least six years from the time that cysts are first detected in the body.

The following composite account is based on an examination of the brains of four men who died of cerebral cysticercosis, and is an attempt to correlate the morbid processes which follow the development of the cysticercus and the accompanying clinical symptoms of brain involvement. In the brain the cysticercus becomes enclosed by a wall of sclerosed neuroglia, corresponding to the fibrous capsule found in extracranial tissues. I do not know how long this neuroglial wall takes to form, but it was well defined in the brain of a man who died eighteen months after his first prodromal symptom of severe headache. It is not the time factor alone that determines the extent of this sclerosis, for the wall around individual parasites in the same brain may differ greatly in thickness. Small round cells and a few plasma cells are present between the delimiting neuroglia and the surrounding normal brain tissues.

Unless the parasites have invaded the brain in overwhelming numbers, or have lodged in some particularly responsive centre, they cause little nervous disturbance while in their relatively quiescent stage, otherwise it seems impossible that anyone could survive for years—as we know to be a fact—with 200 cysticerci present in the brain.

In short, my belief is that cysticerci while alive usually enjoy a relative tolerance on the part of the host, but that after their death they act as foreign irritants and bring about the changes next to be described, partly by their toxic effects and partly by increased pressure, like that which leads to the appearance of "new" cysts in the muscles. Surrounding the dead and disintegrating cysticercus the tissues are seen to be undergoing active degenerative changes, with a marked cellular response both within and without the neuroglial wall which itself is involved in the destructive process. To the naked eye the degenerating tissues may be visible around the cysticercus as a discoloured ring, perhaps three millimetres or thereabouts in depth, shading off into the normal brain tissue. If the patient survives, the damaged tissues may undergo necrosis. This dead area which may extend for at least five millimetres beyond the cysticercus, is ringed off from the normal brain substance by a distinct encircling wall of sclerosed neuroglia.

So that several pathological processes may share, with differing degrees of responsibility, in the production of the clinical picture—the active destructive changes which I suggest are associated with the death and degeneration of the parasite; the tissue necrosis following this severe reaction; and sometimes, possibly, an excessive neuroglia sclerosis around the cysticercus.

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[1] Since the above was written, this patient has been re-examined by Major Dixon (December 19); thirteen more "new" cysts have become evident since July.

In the brain of one man who died in status epilepticus six years after his initial fit, parasites could be seen in the three main stages I have mentioned. Obviously he had survived the reaction to those which were surrounded by a necrosed area, disturbances possibly expressed in the original onset of fits; I believe that the parasites which were causing the active degeneration I have described, were responsible for his death; and that the small and relatively quiescent cysticerci held potentialities for later mischief had the patient not succumbed.

I do not know of any other explanation which will cover the following observed clinical facts: that commonly parasites are present in the body for at least one or two years, and sometimes much longer (e.g. six and eleven years) before brain symptoms become evident; that when these develop they are subject to periods of exacerbation, followed by intervals of relative or absolute quietude; and that the character of the symptoms may vary so markedly that an individual patient seen at intervals by different observers has been diagnosed as delusional insanity, disseminated sclerosis, and cerebral tumour.

After a variable period determined in part by the resistance of the host the parasites in the body tissues die and often undergo calcareous change. What I take to be the classical teaching regarding the sequence of events is, that the fluid in the cyst becomes gelatinous and the whole contents reduced to a caseous mass which eventually calcifies. I do not doubt that this may happen, but up to the present I have not seen any stage of this process in an excised cyst. Our experience has been that calcification commonly commences in the scolex, and in a number of instances we have found an undegenerated bladder wall with its fluid contents unchanged appreciably, and in this a calcified scolex which in at least four cases was lying quite free. So that calcification of the scolex may be complete while the cyst capsule and its other contents are unaffected. From a comparison of excised cysts and radiographic appearances, I believe that calcification may stop at this point and go no further, the cyst wall collapsing through the escape or absorption of the fluid, and disappearing. Or the collapsed cyst may be flattened by the pressure of the surrounding muscle and calcify in an extended form. Again, after calcification the cyst may retain much of its original shape, supported, presumably, by solidified fluid, thus withstanding the pressure of the tissues. Here, too, the degenerative process often commences in the scolex which may be seen heavily calcified at a time when the surrounding mass shows only as a ghost-like shadow. Occasionally the appearances suggest a calcium invasion spreading from without inwards, and from analogy, there seems no reason why this should not take place.

Thus it is evident that the appearance of a calcified cyst is determined mainly by its original size and the presence or otherwise of a host capsule; by the degree of collapse undergone by the cyst wall and the position it assumed; and the final disposition of the contents.

The time that may elapse before calcareous changes commence depends on many variable factors, the most variable being the duration of life of the parasite, for the longevity of individual parasites even in the same host may differ by years. But there is always the possibility that some of the invaders may not have survived long, and so recognizable calcium deposits might reasonably be expected somewhere in the body in a case of a four or five years' duration, or even less. I believe that generally about three years are required after the death of the cysticercus for the scolex to calcify. Radiological examinations made at any relatively early stage should, if negative, be repeated after appropriate intervals.

Calcification in the brain is a much more dilatory process as a rule, and this degenerative change may be complete in the muscles at a time when the cerebral cysts remain unaffected. One ex-soldier in this series was operated on eleven years after the onset of fits. Several cysts removed from the cerebral cortex showed no signs of calcareous change although the cysts in the muscles had then been heavily calcified for three years, and some of them for five years. In one of our cases, radiographs showed calcified cysts in the brain only, and none elsewhere, presumably because the brain alone had been invaded.

Of the nervous manifestations of cysticercosis by far the commonest and most striking is epilepsy. Some people may find this term objectionable, but I use it deliberately for there is no symptomatic character of the type of epilepsy that may be produced to differentiate it from one or other of the classical forms of that disorder. The attacks may be like those of petit mal, or may be Jacksonian in type, with or without loss of consciousness. They may show all the stages of the textbook fit of major epilepsy, with aura, biting of the tongue, relaxation of sphincters, postepileptic stupor, and so forth. In some instances they are irregular in character and show no clear-cut sequence of stages. In this connexion it may be mentioned that a number of ex-soldiers (eventually proved to suffer from cysticercosis) have been diagnosed and demonstrated as cases of cerebral tumour in several teaching hospitals in London and elsewhere.

There may be a long history of incomplete fits—often regarded as hysterical—prior to the commencement of fully-developed major attacks. For example, one man used to stand for a few seconds with his teeth clenched and his left wrist flexed. After about a year of such attacks, one day he was carried into hospital unconscious and within the next twenty-four hours had three major fits, followed by five more in rapid succession a day or two later. Another man, during a period of two years, had momentary attacks during which he flexed his head to one side, being quite conscious of the movements but unable to control them. Three years ago major attacks developed, commencing with three in one day. They still continue at intervals, and recently I learned that when falling in one such fit he had dislocated both shoulders at the same time.

Sometimes fits commence at about the time that cysts are first detected.

In other cases there may be a long latent period between the appearance of cysts and the first seizure. One man developed subcutaneous cysts in 1922. He showed no outward sign of brain involvement for six years, and then, in 1928, had a major epileptic fit. He went down hill rapidly, and eighteen months after his first seizure he is recorded as being very weak and tremulous, scarcely able to walk or stand, and having great difficulty in understanding and answering questions. He died six months later. Again, cysts may become palpable only subsequent to the onset of epileptic attacks. To illustrate this sequence I cite the case of a soldier who developed fits and was discharged the Service as suffering from certified "true epilepsy." Not for four years did cysts commence to show themselves in the muscles, and they have continued to appear at intervals during the succeeding three years, including 1933.

The other signs of involvement of the central nervous system are less dramatic than epilepsy, but they cover an extraordinarily wide range. When we reflect that the embryos may lodge in any part of the brain, it is easy to realize that any symptoms, motor, sensory or mental, which accompany focal lesions in the brain may be produced in cysticercosis. The picture may be that of cerebral tumour with all or any of its classical symptoms, or may resemble disseminated sclerosis, or if there is a hyperinfestation, acute encephalitis. One soldier in this last category survived for only seven days after admission to hospital on his first complaining of intense headache.

With or without fits, psychical disturbances may predominate at times, and the considered diagnoses in cases later proved to be cysticercosis included (besides that *par nobile fratrum*, hysteria and neurasthenia)—melancholia, acute mania, delusional insanity, and dementia præcox. As well as gross mental disturbance which suggests diagnoses such as these, there may be mental dullness, impairment of memory, temporary periods of disorientation, or a change in disposition, so that a previously efficient soldier may become careless and untrustworthy. Indeed, Colonel Benson, commanding the Q. A. Military Hospital, Millbank, has told me with some feeling that if any breach of ward discipline is reported, usually a cysticercosis patient proves to be the delinquent.

I want to make it quite clear that the foregoing are mere phases or stages of the infestation, determined, as I believe, by the waxing and waning of parasites in the brain, and that they are not clinical entities. Some authors divide the disease into so-called "types"—one characterized by headache, another by vertigo, a third by sensory changes, and so on to about twenty in all—and state the relative frequency of each of these in figures. This is a misleading representation of the disease. It results from basing the symptomatic account on published cases collected from the literature. Naturally each was described in whatever stage the observer happened to see it. If these same patients had been examined a year or two earlier, or later, many of them would have been classified as belonging

to quite a different "type." Major H. B. F. Dixon has shown indefatigable energy in ascertaining the early and subsequent histories of the patients in our series. To-night he has brought summaries of the clinical histories of over sixty military cases of proved cysticercosis, and anyone interested can see here how an individual patient when observed from first to last may be seen to pass through every one of the so-called "types" of this terrible disease. An early emphatic entry, "No Fits," does not preclude a final one, "Died in status epilepticus."

Diagnosis.

As is the case in many other maladies, the great impediment to the diagnosis of cysticercosis is the failure to think of the disease actually present. Everybody knows that man may serve as the intermediate host of *T. solium*, but often there is a hiatus between this theoretical knowledge and its practical application. Even as a house physician I was aware of the great danger of handling tapeworm segments carelessly; yet I turn pale when I think of the number of cases of cysticercosis that I must have missed since then. Several times when taking part in examinations for post-graduate qualifications in medicine, I have provided an exceptionally easy case of cysticercosis for the clinical test, mainly as an interesting experiment. The first occasion, over seven years ago, may be taken as typical of the rest. The diagnoses offered included Von Recklinghausen's disease, secondary malignant deposits, and even nodular leprosy. None of these qualified candidates suggested cysticercosis or mentioned it in his discussion as a possibility, however remote.

I do not know of any English textbook that deals with this disease in an adequate manner. In some the account is too brief or too incomplete to be of much practical help. The account in others is a compilation of excerpts from various sources, which only serves to give the reader a misleading picture of what he may encounter. One large and generally admirable work dismisses cysticercosis in two and a half lines, and even in this space room is found to emphasize its rarity. While in the long and detailed account of the causes of epileptiform convulsions it is not even mentioned.

The history in itself may be suggestive—the onset of fits in adults without any evidence of a familial or personal epileptic taint, who are not suffering from neoplasm, syphilis, or the effects of head injury. A history of residence abroad increases the probability of cysticercosis, but persons who have never left England are not exempt from attack. And, of course, infestation may take place at any age. Two of this series were boys aged 13.

The most generally helpful sign in diagnosis is the presence of palpable cysts in the body tissues, and the patient under suspicion should be examined thoroughly from head to foot. Cysts, if not numerous, are easily overlooked. On one occasion I examined an epileptic patient with great care and pro-

nounced him free from palpable cysts ; just as I turned away the sun came out behind him and threw into relief a tiny elevation above one clavicle which I had failed to detect before. This proved to be due to a cysticercus, the only one discovered in his body. Often the patient himself is aware of the presence of nodules, and if these are seated deep in the muscles and difficult to feel, he may demonstrate some digital manipulation, such as manœuvring a cyst against a bone, which experience has taught him to be effective.

In order to demonstrate the parasite, a suitable cyst is excised under local anæsthesia, and freed from any adhering tissue. The host capsule is incised carefully so as not to injure the cysticercus which is gently extracted. The appearance of the translucid membrane with its central "milk spot," representing the invaginated scolex, is characteristic. If alive, the parasite may evaginate the head and neck, or may be induced to do so by immersion in warm saline. Pressure applied to the bladder may succeed if these methods fail, but when the larva is dead and the scolex adherent to the surrounding membrane, dissection will be necessary to display its characters, sometimes a laborious but not otherwise difficult task. When calcareous degeneration is so extensive as to mask the structure of the parasite, the calcium can be dissolved by weak HCl which does not affect the hooklets.

Diagnosis in cysticercosis is more easily established if palpable cysts are present; the disease is no less likely if they have been absent throughout, for in many persons the parasites lodge deep in the muscles, and so escape detection. If palpable cysts are recorded as universally present, at some period, in any considerable series of patients, this is good evidence that many cases of infestation are being overlooked.

When the embryos are active in the body, no doubt an eosinophilia results. But in the established disease when these small parasites have been walled off, as would be expected there is usually no help to be gained from blood-counts.

Presumably for the same reason, the complement-fixation and skin tests—which are group reactions—have not the high degree of success of the corresponding tests in schistosomiasis, filariasis and hydatid disease; and when carried out in known cases of cysticercosis they are more often negative than positive. The complement-fixation test, however, has been of great value on occasion, and in two instances it was positive at a time when all other methods of diagnosis gave no help. Its accuracy was confirmed later in both of these. The greatest need at present is for some reliable means of detecting infestation when the parasites either are actually limited to the brain, or if present elsewhere in the body as well, cannot be discovered. For this purpose the complement-fixation test with its existing limitations does not offer any prospect of success ; for although a positive result points to parasitism, a negative result is valueless and may accompany even very heavy infestation.

There are no constant changes in the spinal fluid, and such deviations

from the normal as may occur have no positive diagnostic significance. Even when profound cerebral disturbance is present, the spinal fluid may remain unaffected. None of our patients showed an eosinophil reaction.

Major W. K. Morrison,[1] lately radiologist at the Q. A. Military Hospital, Millbank, has made a study of the radiological appearances of calcifying and calcified cysts. He compiled the accompanying diagram from the radio-pacities shown in twelve cases of cysticercosis, and although many more positive radiographs have been obtained since then, it has not been found necessary to add to the figures in the diagram. The somewhat fanciful names have been found useful in reporting the presence of parasites.

In practice the diagnosis may become apparent only in course of time—the onset of fits may bring to notice pre-existing cysts in the tissues; or the appearance of belated cysts may suggest the nature of an epilepsy of long standing. Again, the calcification of parasites not previously detectable may determine a diagnosis by radiological examination.

No single series of examinations and tests, however thorough and complete, can be relied on to exclude cysticercosis. Therefore, I emphasize the necessity of keeping cases of suspected or possible cysticercosis under observation, examining them at intervals, and making further X-ray examinations after the lapse of six months or a year.

Diagnosis in some unknown proportion of cases of infestation is impossible during life, and even post-mortem the presence of a few parasites—perhaps only one or two in all—probably would not be detected unless the pathologist has cysticercosis in mind, knows what to look for and leaves no scrap of brain substance more than four millimetres square, unsearched.

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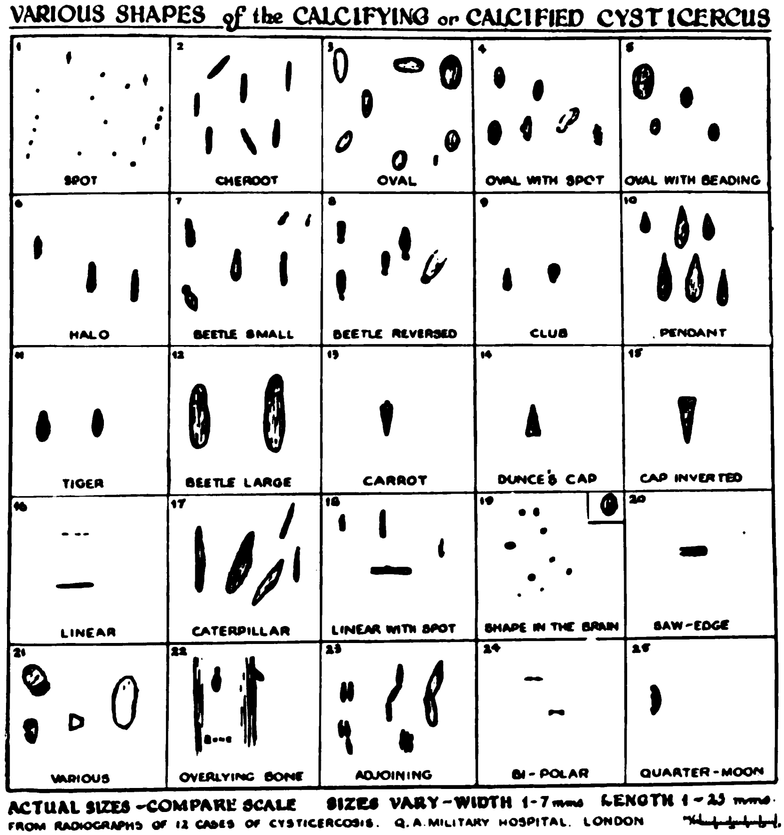
[1] I am indebted to Major Morrison for the following notes on X-ray examination:—

"For routine investigation the following regions are radiographed—skull, lateral view only; root of neck; upper arms; fore-arms; thighs; legs. The films and the intensifying screens should be free from "grain." The Potter-Bucky diaphragm is used only for the skull radiograph. The standard of radiograph aimed at in each region should be that of the ordinary exposure conditions for bone detail, with a very slight under-exposure. It is useless to take the radiograph under special conditions to show soft tissues only.

"The parasite may be represented by a final radiopacity in any form from the calcified scolex (about one millimetre in diameter) up to a fully-grown elliptical cyst (about twenty-three millimetres long). Radiographs are viewed in the ordinary way, but owing to the faint shadow produced by the early calcifying parasite, the search of the soft tissues must be a very thorough one. It is quite easy to miss a small section of a calcified parasite at the upper or lower margins of the films, or to miss one overlying normal bone shadows. Oblique illumination is sometimes of value. If single shadows are observed, the patient's skin should be examined for the presence of warts, scars, or red ink tattoo marks. The shadows often imitate simple film stains, and in case of doubt the radiograph should be repeated. Films should be filed for comparison with those taken at a later date."

It is scarcely necessary to add that the radiologist should familiarize himself with the structure of cysticerci and their developmental history in the body.

Though it may seem incredible to members of a scientific society, I have been asked what is the good of "going to all this trouble" to establish a diagnosis of cysticercosis when little or nothing can be done for the sufferer. There is one obvious advantage to a soldier, for the disease when acquired abroad is rightly held to be attributable to military service. Apart



[*From the "British Medical Journal,* 1934, *Jan.* 6, *p.* 14.]

from this material gain there are other advantages. Men labelled as epileptics, and labelled wrongly as was proved later, have protested, literally with tears in their eyes, that epilepsy was unheard of in their families, and have asked with dismal forebodings whether the disease would show itself in their children. Further, when mental deterioration has advanced so far that the subject becomes certifiable as insane, it is an indescribable relief to all his family and connexion—even though the unfortunate victim himself may gain no benefit—to know that the slur of familial lunacy has been removed.

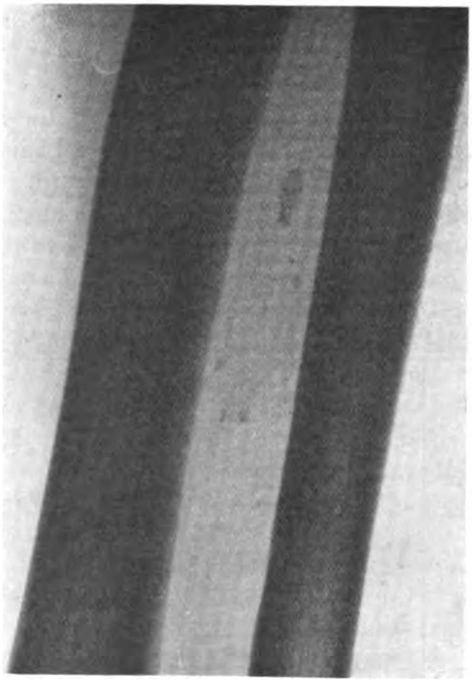


Fig. 1.—One calcified cyst and several calcified scolices. (Eight years after removal of unidentified tapeworm, 6 years after first nodule detected, and 4 years after initial fit). A + ; B +.

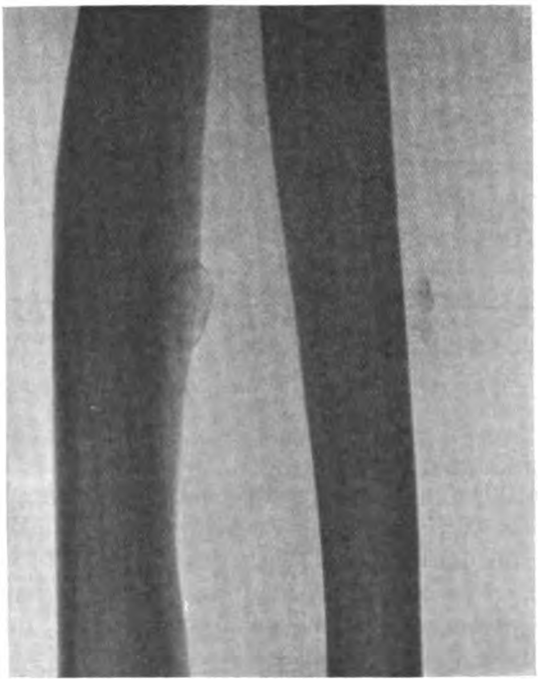


Fig. 2.—Two calcifying cysts. (Seven years after initial fit, and three years after first nodule; no tapeworm). A + ; B −.

A + = Cysticercus excised and identified. B + = Complement-fixation and skin tests positive.
B − = Complement-fixation and skin tests negative.

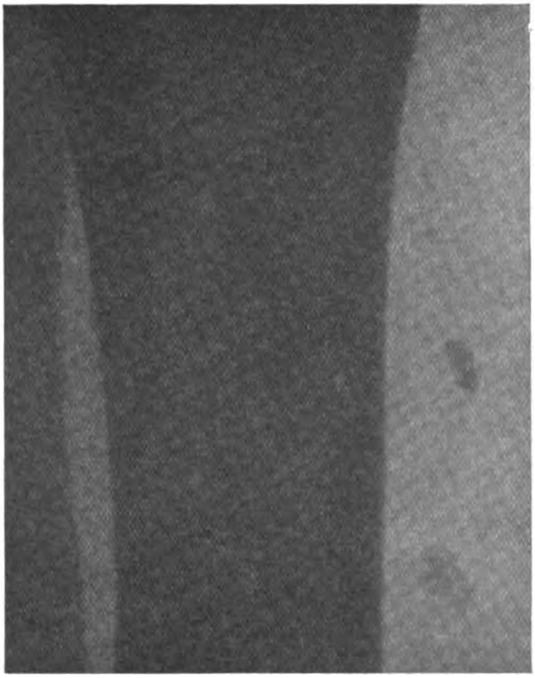


FIG. 3.—Two calcifying cysts. (Six years after initial fit; no nodules detected; no tapeworm.) B —.

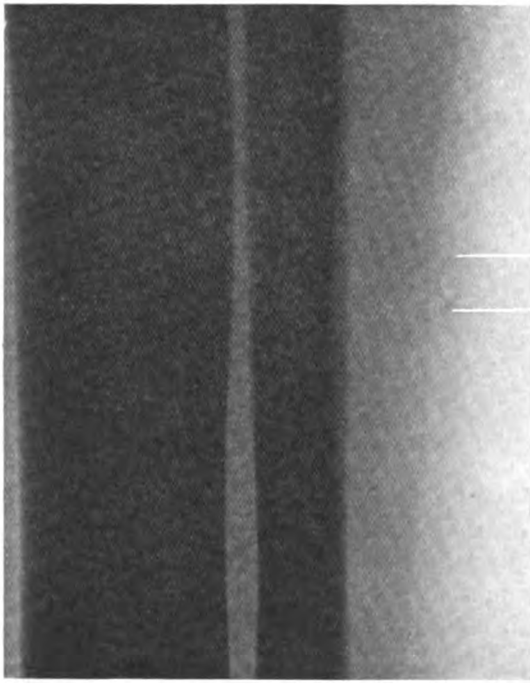


FIG. 4.—A calcareous scolex, presumably free, at lower extremity of calcifying cyst. (Same year as initial fit, but the appearance of the parasite shows that infestation has lasted for several years; subcutaneous lipomata rendered search for palpable cysts ineffective; no tapeworm.) B +.

B — = Complement-fixation and skin tests negative. B + = Complement-fixation and skin tests positive.

Prognosis.

Prognosis in this disease is a matter of extreme difficulty for there is no method of ascertaining during life the number of cysticerci and their distribution in the brain, or of forecasting the vagaries of their future behaviour on which so much depends. The most dangerous time is from the sixth to the eighth year for then the grave intensification of existing cerebral disturbances most frequently takes place, and subjects who have remained free from outward signs of extensive brain involvement are most likely to show them about this time.

The general tendency is one of retrogression, as evidenced by signs of mental deterioration which may be so marked as to necessitate institutional segregation. On the other hand, some patients in spite of persisting epilepsy remain mentally alert; while in four of the series, fits have ceased after a duration which ranged from a few months to twenty years.

Treatment.

The luminal and bromide series are sometimes helpful in controlling fits, but no medicinal treatment so far employed has had any curative effect. Indeed the observations on tissue changes which follow the death of intracerebral cysticerci suggest that the destruction of large numbers of these parasites at the same time—supposing that some chemical of lethal power were forthcoming—might only make matters worse for the sufferer. Of two men who received intravenous injections of antimony tartrate, one developed a crop of "new" cysts afterwards, while in the other, the cysts already present increased in size and the cerebral symptoms became aggravated. These results cannot be attributed to treatment, for similar phenomena are commonly seen in untreated patients, but they are such as would be expected to follow the administration of a parasiticidal drug, unless, possibly, this were employed very early in the course of an infestation before the embryo had attained larval maturity.

The large numbers of parasites found in the brain and their wide distribution there do not encourage a general resort to surgery. The successful removal of cerebral cysts is reported occasionally in the medical press, but before claiming a cure or appraising the degree of permanent improvement, time must be given for any other parasites in the brain to die off, and this may mean years of observation. In actual practice a temporary amelioration of symptoms after removal of one or more cysts has been followed by the death of the patient in status epilepticus.

I should not favour operation except when some restricted and constant localizing sign is present (e.g. aphasia). It is important to remember that muscular spasm if confined to some particular part during a single fit does not necessarily indicate a limited cortical involvement, for when an individual patient is watched in a series of several fits, each of them may be observed to affect a different group of muscles.

The possible extent of indigenous cysticercosis in England is unknown,

for no one has yet searched for the disease. That it can be contracted here is shown by one of our cases, a man who has never left this country. Intestinal infestation by *T. solium* contracted in England is believed to be rare to-day, but there is always a possibility of infested persons returning from abroad, and recently I heard of a man resident for over four years in

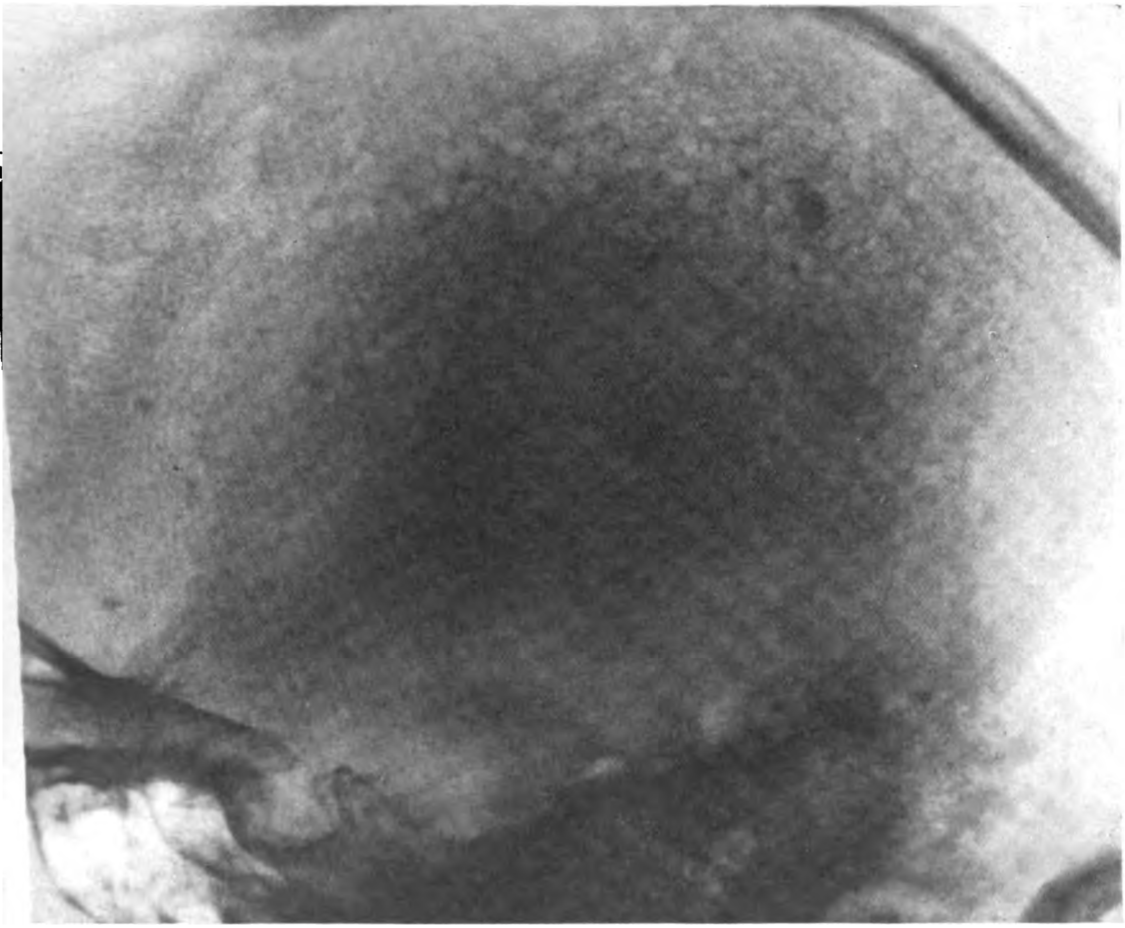


FIG. 5.—One calcified cyst and many calcified scolices in brain. Of twenty-six patients who showed calcified parasites somewhere in the body, positive radiographs of the brain were obtained in five. Calcification in the brain, when it occurs, appears to affect mainly the scolex, and sixty-six cerebral parasites out of seventy-one detected in films showed the scolex type of calcification.

a country district in England, who has been passing segments of *T. solium* throughout this period. To intensify this risk of chance infestation there is a common practice in rural England, as I recently learned to my amazement, of using human dejecta as a fertilizer for vegetable gardens and fields. But apart from the possibility of home-acquired cysticercosis, there are many people in Great Britain who have been exposed to a risk of

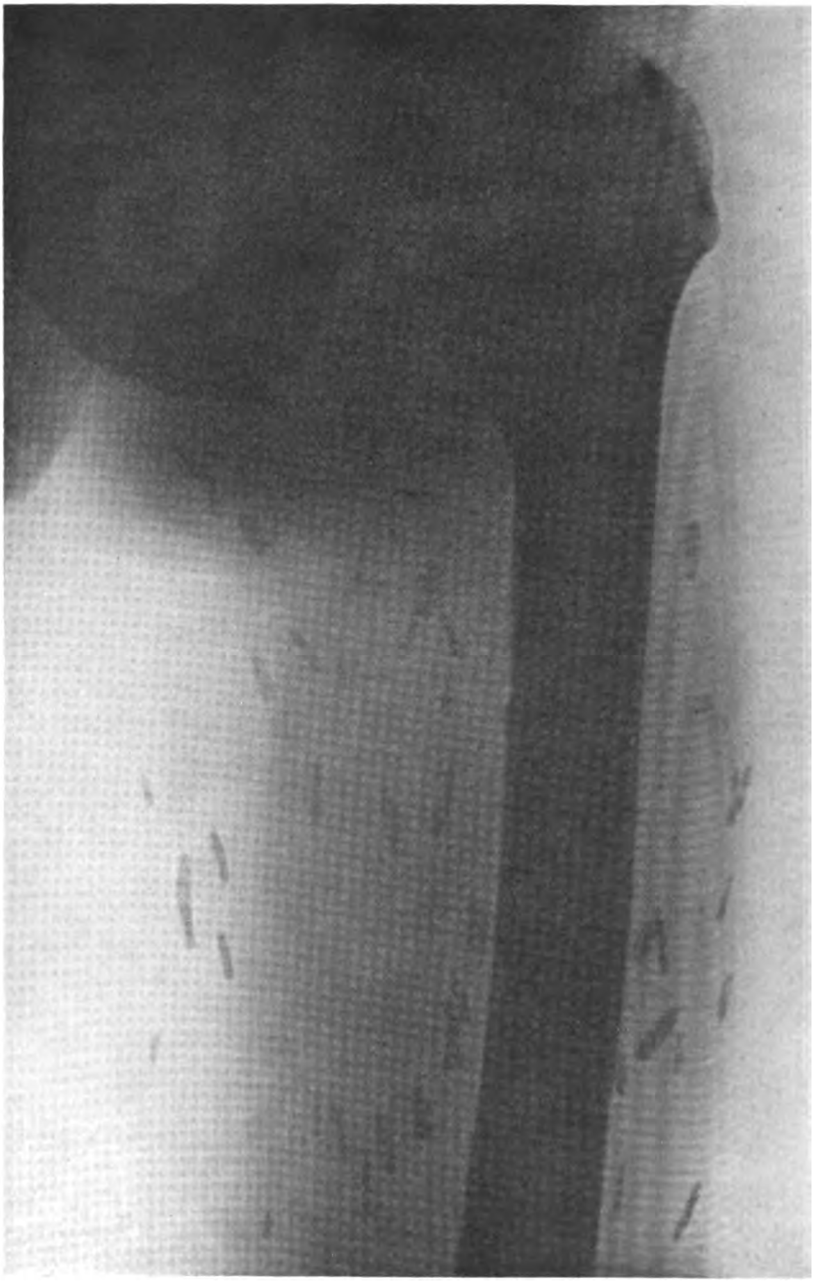


FIG. 6.—Although this type of calcification is well known, the radiograph is included because of the patient's history: Aged 40, served in India 1913-20, Egypt 1920-23; has not left England since 1923. No tapeworm; "never had a day's illness." In October, 1932, had a major epileptic fit, followed by a second in 1933, which was witnessed, and certified as "true epilepsy." The condition shown above is general throughout body. No nodules, and none noticed at any time. Duration of infestation unknown, but clearly it has existed for many years.

[This and the preceding plates are from radiographs provided by the Queen Alexandra Military Hospital, Millbank, London.]

contamination abroad—discharged soldiers and sailors of the regular forces, the tens of thousands who served abroad during the late war, civilians who follow their avocations beyond the seas, and, of late, the crowds of tourists who explore tropical countries with a zeal undamped by any knowledge of preventive medicine. I should like to enlarge somewhat on the group mentioned first, in case my words may reach the general practitioner. Our experience suggests that there are many undiscovered sufferers from cysticercosis among army reservists and discharged soldiers. Men who develop fits after leaving the Army hide their disability and deny it if questioned, for they live in dread of losing their few weekly shillings of reservists' pay. Fits to them mean epilepsy, and they know that (true) epilepsy as a "constitutional" disease is regarded as not attributable to military service. Several ex-soldiers who had lost job after job because of "fits"—one of them an inmate of a workhouse—made despairing appeals *ad misericordiam*, and have been found to be victims of cysticercosis. There must be many others throughout the country.

Our investigation gives at least some indication of the serious extent of cysticercosis in the Army. It is not a military disease in any sense, and there is nothing in the ordinary life of a soldier to render him more likely to contract infestation than other persons resident in the countries where British troops serve. Of these, we know that the disease has originated in India, Egypt and Malaya, and probably in other countries as well, but because of changes of station during the long presymptomatic period so commonly present, it is often impossible to say where the disease was contracted. I see no reason to suppose that the European civilians in these countries are entirely exempt from attack.

If a commission of persons who have studied this disease, especially in its more elusive forms, were to search diligently in lunatic asylums, institutions for epilepsy, and general hospitals, I think that the results would be surprising. If such an inquisition did not bring to light hundreds of unsuspected cases of cysticercosis, I should regard this as the greatest miracle since Moses smote the rock.

[We regret that owing to limitations of space we are unable to reprint the discussion which followed Colonel MacArthur's paper.—ED.]

AIR AMBULANCES.

By Colonel E. M. COWELL, D.S.O., D.L., M.D. F.R.C.S
Territorial Army.

I. Introduction.

This paper was read before the United Services Section of the Royal Society of Medicine in December, 1933.

In introducing the subject of Medical Air Transport, much of the ground covered may be familiar to many. Most of the facts have already been published, and the subject has been fully dealt with in reports issued by the International Congress of Aviation Sanitaire of 1929, and in subsequent proceedings of conferences held in Paris, under the auspices of the League of International Red Cross Societies.

The subject of Air Medical Transport was first brought acutely to the writer's notice by Major-General P. H. Henderson, D.S.O., K.H.P., in a lecture at the Services Section of the Royal Society of Medicine in April, 1931.

In that lecture it was pointed out that, in this country, we had as yet no organized Medical Transport Service for use in case of war or civil emergencies.

Financial considerations, together with a shortage of Royal Air Force Flying Officers, render a Service Medical Transport scheme impossible, at any rate at present.

The difficulty has been overcome by collecting a voluntary flying personnel, organized by the British Red Cross Society and sanctioned by the Air Ministry.

In case of need, volunteers will be called for and mobilized as required. As will be shown later, Air Ambulance Detachments now exist in Great Britain, consisting of a personnel of highly experienced pilots, men and women, trained in First Aid and also in the special task of transporting casualties by air.

II. Historical Review.

Probably the first reference in literature to the subject was by that wonderful prophet, Jules Verne, who in his book, "Robur le Conquérant," describes the rescue of shipwrecked men by an airship "the Albatros."

From 1890 to 1911, M. de Mooy, a Dutch doctor, was working at medical aviation both with balloons and aeroplanes.

Mlle. Marvingt, a medical student and aviator was his colleague, and proposed plans for air ambulance work of a military nature. From this date onwards the French have taken the keenest interest in "Aviation Sanitaire."

In 1913 at the Société de Médecine Militaire, M. Uzac read an

exhaustive paper, and M. Julliot advocated protection of the machines by the Geneva Cross.

In 1915 successful air evacuations were made by the French in Albania. In the Great War casualties were too numerous and machines too few and not suited for transporting wounded by air.

However, towards the end of the War, in 1917, Dr. Chassaing, working with M. Justin Godart, designed a lateral opening to enable two superimposed stretchers to be carried in the "dead space" of the fuselage.

Subsequently in the fighting in Morocco and Syria Medical Air Transport began to be used.

The value of this service was recognized by Marshal Lyautey, and under the direction of Colonel Cheutin, the 37th Regiment of Aviation carried more than 1,050 wounded in the first ten months of 1923.

Here, a new type of machine was introduced called the *Aerochir*, to enable the surgeon and his team to proceed direct to a casualty and operate on the Field.

The use of such an outfit is however not of great value. All agree it is better to operate on casualties after they have been moved into the safety and comfort of a hospital.

For transporting wounded it was found that two types of machine were necessary. (1) The large Breguet-Limousine, capable of carrying eight to ten cases, and (2) the small Hanriot biplane, carrying one or two stretcher cases besides the pilot. The latter requires but little landing space and can be operated in difficult country. In the next two years more than 4,000 casualties were evacuated by air in Morocco.

General Denain reported that following fighting on the "Euphrates," eighty severely wounded were carried by air, in the space of two days, to the base hospital 400 kilometres (250 miles) away. This journey occupied four hours as against five days by motor ambulance, or fifteen days by mule transport, through desert country threatened by hostile tribes.

III. (A.) Details of Air Medical Transport used by the French (Military).

Special air ambulance machines were first used in Morocco, where it had been foreseen that this method of evacuation would be useful in desert warfare.

In September, 1918, eighteen wounded were carried from Tafilalet to Bou-Denib. After this, the service was gradually developed. It was reported that the early pilots were not keen and did not manifest excessive zeal for this work.

The first machines were not very successful, but in 1920 twenty machines were provided for Morocco and sixteen for the Levant.

In 1921 these machines arrived in Morocco; they were the Hanriot type with two stretchers carried superimposed in the fuselage and loaded by means of a lateral porthole.

From 1921 to 1928, 3,969 cases were carried with two fatal accidents, both incurred when the machines were taking off. Picked pilots were always chosen, with at least 400 hours flying experience and training in medical transport. It has been observed that although the pilots do this work as part of their general duties, they generally prefer their fighting missions. The large machines were not favoured by the pilots and the small Hanriots (H 13-S) were generally used.

It was found by experience that the Chassaing arrangement was not very roomy, although comfortable. Also that the tendency for the patient to slip off the stretcher had to be met by the provision of sheepskin bags.

Severe fractures with splints could not be carried in the smaller machines, and the patient was worried by the absence of visibility.

The larger Breguet-Limousine type is excellent but difficult to load, since a special stretcher is required. A very large door is needed for loading the standard stretcher.

The casualties were generally sent unaccompanied. In January, 1929, the Moroccan Air Medical Service consisted of twenty-six Breguet machines and seventeen Hanriots.

In the Levant from 1921 to 1928, 1,392 evacuations were carried out. Here also a careful preliminary organization was found to be necessary. Depots were arranged with adequate supplies of equipment and stores, in charge of engineer-officers and mechanics. Suitable landing places were chosen and the surface of the ground well prepared.

Arrangements were made for wireless communication, so that on the receipt of a message from a reconnoitring column an ambulance machine could be sent out at once.

In one series of fifty cases carried in the Levant by the Breguet machines, seven died later, but none were reported on arrival as having suffered from the journey.

(B) General Considerations of Military Medical Air Transport.

It is a surgical axiom that in order to save life serious cases must be operated on in from four to twelve hours, less serious in under twenty-four hours and the other cases within thirty-six hours. The sooner the lightly wounded man is treated, the sooner he can be returned to duty.

It is generally agreed that in view of the existence of long-range guns, wounded must be treated at least twenty to thirty miles behind the firing line.

It is possible to do major operations close to the firing line in well protected dug-outs, but such cases do badly, will not stand evacuation, and, moreover, casualties must be cleared early, otherwise the movements of the fighting troops may be hampered, quite apart from the question of morale.

The technical medical personnel is best employed further back. Front line treatment should consist of efficient first-aid and rapid evacuation.

The French authorities estimate that a division engaged in active major operations will sustain 600 casualties a day, and of these 17 per cent will be serious cases requiring air transport. It is found that 4 per cent of these cases will be of the first urgency, and 13 per cent of the second urgency. The daily air evacuations will therefore total 102 cases.

The range of action of an air ambulance is about 300 miles, three hours' flight. A machine can make 2 to 3 trips in the summer or 3 to 4 trips if night flying is allowed. From this it follows that an establishment of 2 to 3 large ambulance machines per division is required.

As regards the limit of safety for the forward landing grounds, it is considered that no site less than ten kilometres (about six miles) behind the front line must be thought of. This is in the area of Corps Headquarters, where the danger of shell fire is less and where the ground can be marked by protecting signs.

These forward landing grounds will be organized as Air Collecting Stations, chosen by an Air Force Officer working in liaison with an R.A.M.C. Officer. Motor Transport or wheeled stretchers will be required and a careful selection of cases will be made by an experienced officer.

The Air Collecting Stations must be in communication by wireless with the base from which the air ambulances are coming.

(C) Civil Use of Air Ambulances.

The French colonial authorities have organized an extensive Air Ambulance Service.

It is considered that colonists have a greater sense of security, when they know that in case of illness, they or members of their families can be rapidly transported to hospital.

The first essential is the provision of landing grounds, adequate and plentiful. Secondly, the machine employed must be a good flyer, capable of taking off and landing in a minimal space. It must be able to carry a stretcher, doctor or orderly, and a relative. The cabin must be closed, heated and ventilated. For long journeys wireless should be installed.

The Swedish Red Cross have run an Air Ambulance Service since 1924 most successfully.

In Australia an Inland Air Mission is functioning and has been the means of saving many lives.

Italy, Poland, and many other countries have successful air ambulance organizations.

IV. Physiological and Psychological Effects of Air Transport on Casualties.

In normal circumstances it is not necessary to fly above 7,000 feet, that is to a depression of 210 mm. of mercury. This will not provoke any effects beyond a lowering of temperature, which drops about 5° C., for each 3,000 feet of altitude. The machine must therefore be closed and provided with means of giving warmth if required.

The effects of a lowered barometric pressure have been studied on animals suffering from lesions of blood-vessels. Superficial wounds controlled by bandages are not affected, but wounds of abdominal vessels tend to bleed.

Clinically, men suffering from cardiovascular lesions are affected by altitude. The possibility of air sickness too must be taken into account, with its exhausting effects.

Observations on chest cases show that height does not affect seriously the comfort or safety of the patient, but there is the danger of increasing internal bleeding.

Head injuries have been studied in rabbits and it has been found that after trephining and subjecting to a low pressure, epileptiform attacks are apt to occur.

In the alimentary canal, the volume of intestinal gas increases as the pressure is diminished. Experimentally, intestinal contents escape more freely the greater the altitude. If a wound of the abdominal wall exists, the abdominal contents may even herniate.

From the scientific standpoint, therefore, it may be concluded that it is safe to transport cases of wounds of the surface or limbs, where hæmorrhage has been arrested, but that the transport of wounds of the abdomen, chest or head, should only be undertaken after careful deliberation. In actual practice, however, hundreds of such cases have been successfully evacuated by air. The possible risks consequent on air transport are less dangerous than the certainty of fatal consequences if the man is not evacuated rapidly to hospital. However, in view of the above considerations, the pilot should be instructed to maintain his flight at low altitudes. If it is found necessary to fly at greater heights some suitable method of giving oxygen must be arranged.

As regards the psychological effects on the wounded man, if he is loaded with gentleness into a comfortable machine, he is only too happy at the thought of rapid evacuation to hospital. A very seriously wounded man is too ill to worry. After the noise of an active bombardment, the roar of an aeroplane's engines, flying rapidly to help and safety, is music in the patient's ears.

V. Protection of Air Ambulances by the Geneva Cross.

After many years of discussion the protection of aeroplanes used for medical transport in theatres of war has at last been recognized. Certain regulations must be observed as to flying over enemy territory, etc., but if these conditions are fulfilled the Red Cross will be respected. It is desirable that air ambulance machines should be of a distinctive uniform colour, such as dead white, so that even if the crosses are not visible, the machine can easily be distinguished.

The British Red Cross Scheme.

An organized Medical Air Transport Service now exists in this country and sanction has been received from the Air Ministry for the formation of Air Ambulance Detachments, raised and recruited by the British Red Cross Society. It is not at present proposed to collect a large fleet of ambulance machines; the expense is prohibitive. It is, however, possible to enlist a personnel of pilots, engineers and mechanics, trained in first aid and ambulance work. These men and women are members of the Society and are ready to volunteer for active service overseas if called upon.

The establishment of an Air Ambulance Detachment consists of a Pilot Commandant, three pilots, two ground engineers, two mechanics and a clerk. The pilots must hold B licences, which means they are expert aviators. The personnel is recruited from members of Flying Clubs and the smaller Air Transport Companies. They train at their own expense. It is intended also to enlist pilots, who, having been on the R.A.F. Reserve are now too old for fighting, and women who possess the necessary qualifications and who are suitable for the purpose. The scheme has only recently been launched but has already met with encouraging success.

Air Escort Duties.

The Society is also commencing a scheme for training men and women to attend casualties during their evacuation by air. Selected members of the B.R.C.S. are encouraged to gain flying experience, and practices are arranged to afford opportunities of attending to patients in the air.

A certificate of air-worthiness will be given, in accordance with a recommendation made by the International Committee in Paris.

VI. Adaptation of Commercial Machines for Ambulance Purposes.

This problem has been considered by the International League of the Red Cross Societies. It is not proposed to keep special machines for ambulance purposes, the expense of providing the machines and the upkeep is too great. As new machines are being designed and built, however, manufacturers are keeping the ambulance question in mind. General Aircraft Limited, of Croydon, have recently turned out a splendid machine (The Monospar, S.T.4) which will carry a pilot, medical officer or orderly, and two lying cases on the ordinary army pattern stretcher. Loading is easy by means of a large lateral flap on each side of the cabin (fig. 1).

The machine has twin engines, a cruising range of over 400 miles without refuelling, and a speed of 110 to 115 miles per hour. When fully loaded it will take off in 84 yards and land in 110 yards in still air. Wireless can be carried, and the cabin is light, warm and well ventilated. The wings can be folded so that hangarage is economical. The Society has two small Desoutter monoplanes. Unfortunately this machine is no longer manufactured. Two years ago it was the only cabin monoplane which

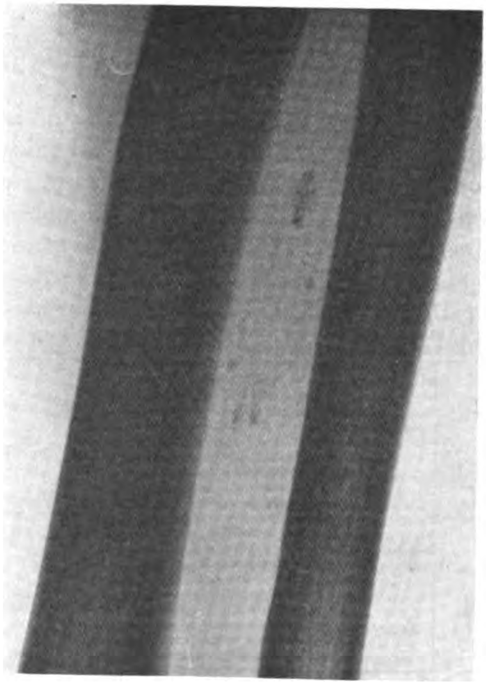


FIG. 1.—One calcified cyst and several calcified scolices. (Eight years after removal of unidentified tapeworm, 6 years after first nodule detected, and 4 years after initial fit). A + ; B +.

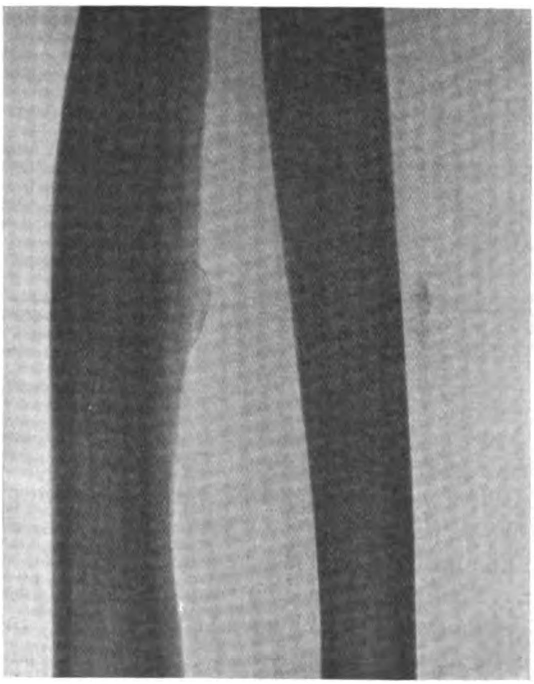


FIG. 2.—Two calcifying cysts. (Seven years after initial fit, and three years after first nodule; no tapeworm). A + ; B −.

A + = Cysticercus excised and identified. B + = Complement-fixation and skin tests positive.
B − = Complement-fixation and skin tests negative.

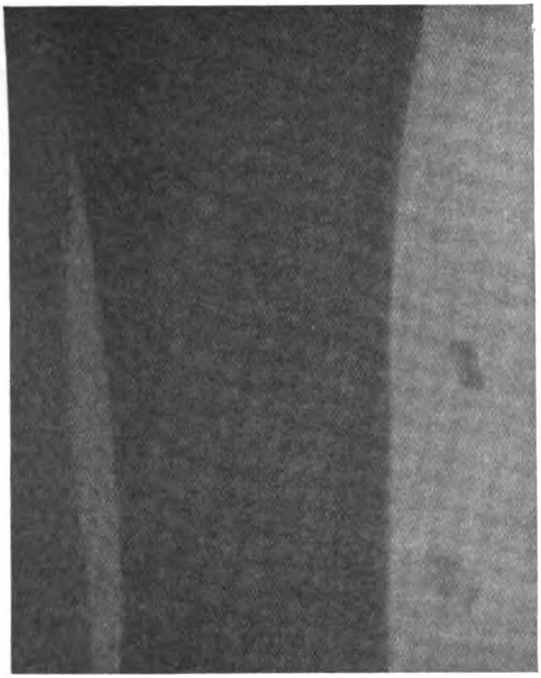


Fig. 3.—Two calcifying cysts. (Six years after initial fit; no nodules detected; no tapeworm.)
B —.

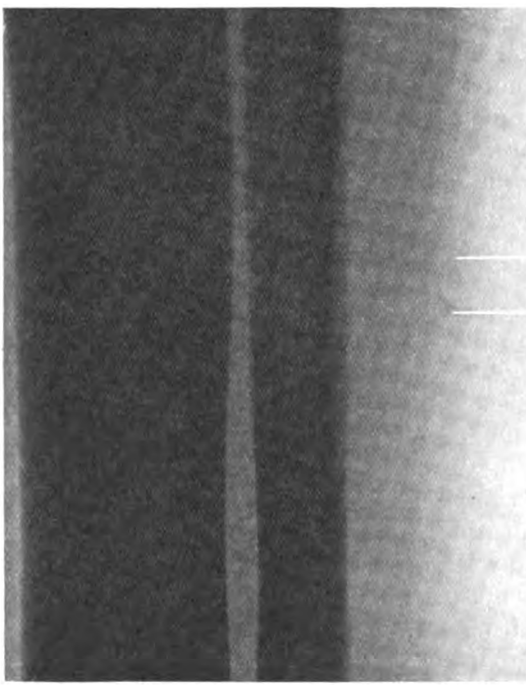


Fig. 4.—A calcareous scolex, presumably free, at lower extremity of calcifying cyst. (Same year as initial fit, but the appearance of the parasite shows that infestation has lasted for several years; subcutaneous lipomata rendered search for palpable cysts ineffective; no tapeworm.)
B +.

B — = Complement-fixation and skin tests negative. B + = Complement-fixation and skin tests positive.

tissues.[1] I think, too, that allied changes affecting the intracerebral parasites explain the long delay in the onset of brain symptoms in certain cases of cysticercosis, a latent period that may extend to at least six years from the time that cysts are first detected in the body.

The following composite account is based on an examination of the brains of four men who died of cerebral cysticercosis, and is an attempt to correlate the morbid processes which follow the development of the cysticercus and the accompanying clinical symptoms of brain involvement. In the brain the cysticercus becomes enclosed by a wall of sclerosed neuroglia, corresponding to the fibrous capsule found in extracranial tissues. I do not know how long this neuroglial wall takes to form, but it was well defined in the brain of a man who died eighteen months after his first prodromal symptom of severe headache. It is not the time factor alone that determines the extent of this sclerosis, for the wall around individual parasites in the same brain may differ greatly in thickness. Small round cells and a few plasma cells are present between the delimiting neuroglia and the surrounding normal brain tissues.

Unless the parasites have invaded the brain in overwhelming numbers, or have lodged in some particularly responsive centre, they cause little nervous disturbance while in their relatively quiescent stage, otherwise it seems impossible that anyone could survive for years—as we know to be a fact—with 200 cysticerci present in the brain.

In short, my belief is that cysticerci while alive usually enjoy a relative tolerance on the part of the host, but that after their death they act as foreign irritants and bring about the changes next to be described, partly by their toxic effects and partly by increased pressure, like that which leads to the appearance of "new" cysts in the muscles. Surrounding the dead and disintegrating cysticercus the tissues are seen to be undergoing active degenerative changes, with a marked cellular response both within and without the neuroglial wall which itself is involved in the destructive process. To the naked eye the degenerating tissues may be visible around the cysticercus as a discoloured ring, perhaps three millimetres or thereabouts in depth, shading off into the normal brain tissue. If the patient survives, the damaged tissues may undergo necrosis. This dead area which may extend for at least five millimetres beyond the cysticercus, is ringed off from the normal brain substance by a distinct encircling wall of sclerosed neuroglia.

So that several pathological processes may share, with differing degrees of responsibility, in the production of the clinical picture—the active destructive changes which I suggest are associated with the death and degeneration of the parasite; the tissue necrosis following this severe reaction; and sometimes, possibly, an excessive neuroglia sclerosis around the cysticercus.

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[1] Since the above was written, this patient has been re-examined by Major Dixon (December 19); thirteen more "new" cysts have become evident since July.

In the brain of one man who died in status epilepticus six years after his initial fit, parasites could be seen in the three main stages I have mentioned. Obviously he had survived the reaction to those which were surrounded by a necrosed area, disturbances possibly expressed in the original onset of fits; I believe that the parasites which were causing the active degeneration I have described, were responsible for his death; and that the small and relatively quiescent cysticerci held potentialities for later mischief had the patient not succumbed.

I do not know of any other explanation which will cover the following observed clinical facts: that commonly parasites are present in the body for at least one or two years, and sometimes much longer (e.g. six and eleven years) before brain symptoms become evident; that when these develop they are subject to periods of exacerbation, followed by intervals of relative or absolute quietude; and that the character of the symptoms may vary so markedly that an individual patient seen at intervals by different observers has been diagnosed as delusional insanity, disseminated sclerosis, and cerebral tumour.

After a variable period determined in part by the resistance of the host the parasites in the body tissues die and often undergo calcareous change. What I take to be the classical teaching regarding the sequence of events is, that the fluid in the cyst becomes gelatinous and the whole contents reduced to a caseous mass which eventually calcifies. I do not doubt that this may happen, but up to the present I have not seen any stage of this process in an excised cyst. Our experience has been that calcification commonly commences in the scolex, and in a number of instances we have found an undegenerated bladder wall with its fluid contents unchanged appreciably, and in this a calcified scolex which in at least four cases was lying quite free. So that calcification of the scolex may be complete while the cyst capsule and its other contents are unaffected. From a comparison of excised cysts and radiographic appearances, I believe that calcification may stop at this point and go no further, the cyst wall collapsing through the escape or absorption of the fluid, and disappearing. Or the collapsed cyst may be flattened by the pressure of the surrounding muscle and calcify in an extended form. Again, after calcification the cyst may retain much of its original shape, supported, presumably, by solidified fluid, thus withstanding the pressure of the tissues. Here, too, the degenerative process often commences in the scolex which may be seen heavily calcified at a time when the surrounding mass shows only as a ghost-like shadow. Occasionally the appearances suggest a calcium invasion spreading from without inwards, and from analogy, there seems no reason why this should not take place.

Thus it is evident that the appearance of a calcified cyst is determined mainly by its original size and the presence or otherwise of a host capsule; by the degree of collapse undergone by the cyst wall and the position it assumed; and the final disposition of the contents.

The time that may elapse before calcareous changes commence depends on many variable factors, the most variable being the duration of life of the parasite, for the longevity of individual parasites even in the same host may differ by years. But there is always the possibility that some of the invaders may not have survived long, and so recognizable calcium deposits might reasonably be expected somewhere in the body in a case of a four or five years' duration, or even less. I believe that generally about three years are required after the death of the cysticercus for the scolex to calcify. Radiological examinations made at any relatively early stage should, if negative, be repeated after appropriate intervals.

Calcification in the brain is a much more dilatory process as a rule, and this degenerative change may be complete in the muscles at a time when the cerebral cysts remain unaffected. One ex-soldier in this series was operated on eleven years after the onset of fits. Several cysts removed from the cerebral cortex showed no signs of calcareous change although the cysts in the muscles had then been heavily calcified for three years, and some of them for five years. In one of our cases, radiographs showed calcified cysts in the brain only, and none elsewhere, presumably because the brain alone had been invaded.

Of the nervous manifestations of cysticercosis by far the commonest and most striking is epilepsy. Some people may find this term objectionable, but I use it deliberately for there is no symptomatic character of the type of epilepsy that may be produced to differentiate it from one or other of the classical forms of that disorder. The attacks may be like those of petit mal, or may be Jacksonian in type, with or without loss of consciousness. They may show all the stages of the textbook fit of major epilepsy, with aura, biting of the tongue, relaxation of sphincters, postepileptic stupor, and so forth. In some instances they are irregular in character and show no clear-cut sequence of stages. In this connexion it may be mentioned that a number of ex-soldiers (eventually proved to suffer from cysticercosis) have been diagnosed and demonstrated as cases of cerebral tumour in several teaching hospitals in London and elsewhere.

There may be a long history of incomplete fits—often regarded as hysterical—prior to the commencement of fully-developed major attacks. For example, one man used to stand for a few seconds with his teeth clenched and his left wrist flexed. After about a year of such attacks, one day he was carried into hospital unconscious and within the next twenty-four hours had three major fits, followed by five more in rapid succession a day or two later. Another man, during a period of two years, had momentary attacks during which he flexed his head to one side, being quite conscious of the movements but unable to control them. Three years ago major attacks developed, commencing with three in one day. They still continue at intervals, and recently I learned that when falling in one such fit he had dislocated both shoulders at the same time.

Sometimes fits commence at about the time that cysts are first detected.

In other cases there may be a long latent period between the appearance of cysts and the first seizure. One man developed subcutaneous cysts in 1922. He showed no outward sign of brain involvement for six years, and then, in 1928, had a major epileptic fit. He went down hill rapidly, and eighteen months after his first seizure he is recorded as being very weak and tremulous, scarcely able to walk or stand, and having great difficulty in understanding and answering questions. He died six months later. Again, cysts may become palpable only subsequent to the onset of epileptic attacks. To illustrate this sequence I cite the case of a soldier who developed fits and was discharged the Service as suffering from certified "true epilepsy." Not for four years did cysts commence to show themselves in the muscles, and they have continued to appear at intervals during the succeeding three years, including 1933.

The other signs of involvement of the central nervous system are less dramatic than epilepsy, but they cover an extraordinarily wide range. When we reflect that the embryos may lodge in any part of the brain, it is easy to realize that any symptoms, motor, sensory or mental, which accompany focal lesions in the brain may be produced in cysticercosis. The picture may be that of cerebral tumour with all or any of its classical symptoms, or may resemble disseminated sclerosis, or if there is a hyperinfestation, acute encephalitis. One soldier in this last category survived for only seven days after admission to hospital on his first complaining of intense headache.

With or without fits, psychical disturbances may predominate at times, and the considered diagnoses in cases later proved to be cysticercosis included (besides that *par nobile fratrum*, hysteria and neurasthenia)—melancholia, acute mania, delusional insanity, and dementia præcox. As well as gross mental disturbance which suggests diagnoses such as these, there may be mental dullness, impairment of memory, temporary periods of disorientation, or a change in disposition, so that a previously efficient soldier may become careless and untrustworthy. Indeed, Colonel Benson, commanding the Q. A. Military Hospital, Millbank, has told me with some feeling that if any breach of ward discipline is reported, usually a cysticercosis patient proves to be the delinquent.

I want to make it quite clear that the foregoing are mere phases or stages of the infestation, determined, as I believe, by the waxing and waning of parasites in the brain, and that they are not clinical entities. Some authors divide the disease into so-called "types"—one characterized by headache, another by vertigo, a third by sensory changes, and so on to about twenty in all—and state the relative frequency of each of these in figures. This is a misleading representation of the disease. It results from basing the symptomatic account on published cases collected from the literature. Naturally each was described in whatever stage the observer happened to see it. If these same patients had been examined a year or two earlier, or later, many of them would have been classified as belonging

to quite a different "type." Major H. B. F. Dixon has shown indefatigable energy in ascertaining the early and subsequent histories of the patients in our series. To-night he has brought summaries of the clinical histories of over sixty military cases of proved cysticercosis, and anyone interested can see here how an individual patient when observed from first to last may be seen to pass through every one of the so-called "types" of this terrible disease. An early emphatic entry, "No Fits," does not preclude a final one, "Died in status epilepticus."

Diagnosis.

As is the case in many other maladies, the great impediment to the diagnosis of cysticercosis is the failure to think of the disease actually present. Everybody knows that man may serve as the intermediate host of *T. solium*, but often there is a hiatus between this theoretical knowledge and its practical application. Even as a house physician I was aware of the great danger of handling tapeworm segments carelessly; yet I turn pale when I think of the number of cases of cysticercosis that I must have missed since then. Several times when taking part in examinations for post-graduate qualifications in medicine, I have provided an exceptionally easy case of cysticercosis for the clinical test, mainly as an interesting experiment. The first occasion, over seven years ago, may be taken as typical of the rest. The diagnoses offered included Von Recklinghausen's disease, secondary malignant deposits, and even nodular leprosy. None of these qualified candidates suggested cysticercosis or mentioned it in his discussion as a possibility, however remote.

I do not know of any English textbook that deals with this disease in an adequate manner. In some the account is too brief or too incomplete to be of much practical help. The account in others is a compilation of excerpts from various sources, which only serves to give the reader a misleading picture of what he may encounter. One large and generally admirable work dismisses cysticercosis in two and a half lines, and even in this space room is found to emphasize its rarity. While in the long and detailed account of the causes of epileptiform convulsions it is not even mentioned.

The history in itself may be suggestive—the onset of fits in adults without any evidence of a familial or personal epileptic taint, who are not suffering from neoplasm, syphilis, or the effects of head injury. A history of residence abroad increases the probability of cysticercosis, but persons who have never left England are not exempt from attack. And, of course, infestation may take place at any age. Two of this series were boys aged 13.

The most generally helpful sign in diagnosis is the presence of palpable cysts in the body tissues, and the patient under suspicion should be examined thoroughly from head to foot. Cysts, if not numerous, are easily overlooked. On one occasion I examined an epileptic patient with great care and pro-

nounced him free from palpable cysts; just as I turned away the sun came out behind him and threw into relief a tiny elevation above one clavicle which I had failed to detect before. This proved to be due to a cysticercus, the only one discovered in his body. Often the patient himself is aware of the presence of nodules, and if these are seated deep in the muscles and difficult to feel, he may demonstrate some digital manipulation, such as manœuvring a cyst against a bone, which experience has taught him to be effective.

In order to demonstrate the parasite, a suitable cyst is excised under local anæsthesia, and freed from any adhering tissue. The host capsule is incised carefully so as not to injure the cysticercus which is gently extracted. The appearance of the translucid membrane with its central "milk spot," representing the invaginated scolex, is characteristic. If alive, the parasite may evaginate the head and neck, or may be induced to do so by immersion in warm saline. Pressure applied to the bladder may succeed if these methods fail, but when the larva is dead and the scolex adherent to the surrounding membrane, dissection will be necessary to display its characters, sometimes a laborious but not otherwise difficult task. When calcareous degeneration is so extensive as to mask the structure of the parasite, the calcium can be dissolved by weak HCl which does not affect the hooklets.

Diagnosis in cysticercosis is more easily established if palpable cysts are present; the disease is no less likely if they have been absent throughout, for in many persons the parasites lodge deep in the muscles, and so escape detection. If palpable cysts are recorded as universally present, at some period, in any considerable series of patients, this is good evidence that many cases of infestation are being overlooked.

When the embryos are active in the body, no doubt an eosinophilia results. But in the established disease when these small parasites have been walled off, as would be expected there is usually no help to be gained from blood-counts.

Presumably for the same reason, the complement-fixation and skin tests—which are group reactions—have not the high degree of success of the corresponding tests in schistosomiasis, filariasis and hydatid disease; and when carried out in known cases of cysticercosis they are more often negative than positive. The complement-fixation test, however, has been of great value on occasion, and in two instances it was positive at a time when all other methods of diagnosis gave no help. Its accuracy was confirmed later in both of these. The greatest need at present is for some reliable means of detecting infestation when the parasites either are actually limited to the brain, or if present elsewhere in the body as well, cannot be discovered. For this purpose the complement-fixation test with its existing limitations does not offer any prospect of success; for although a positive result points to parasitism, a negative result is valueless and may accompany even very heavy infestation.

There are no constant changes in the spinal fluid, and such deviations

from the normal as may occur have no positive diagnostic significance. Even when profound cerebral disturbance is present, the spinal fluid may remain unaffected. None of our patients showed an eosinophil reaction.

Major W. K. Morrison,[1] lately radiologist at the Q. A. Military Hospital, Millbank, has made a study of the radiological appearances of calcifying and calcified cysts. He compiled the accompanying diagram from the radiopacities shown in twelve cases of cysticercosis, and although many more positive radiographs have been obtained since then, it has not been found necessary to add to the figures in the diagram. The somewhat fanciful names have been found useful in reporting the presence of parasites.

In practice the diagnosis may become apparent only in course of time—the onset of fits may bring to notice pre-existing cysts in the tissues; or the appearance of belated cysts may suggest the nature of an epilepsy of long standing. Again, the calcification of parasites not previously detectable may determine a diagnosis by radiological examination.

No single series of examinations and tests, however thorough and complete, can be relied on to exclude cysticercosis. Therefore, I emphasize the necessity of keeping cases of suspected or possible cysticercosis under observation, examining them at intervals, and making further X-ray examinations after the lapse of six months or a year.

Diagnosis in some unknown proportion of cases of infestation is impossible during life, and even post-mortem the presence of a few parasites—perhaps only one or two in all—probably would not be detected unless the pathologist has cysticercosis in mind, knows what to look for and leaves no scrap of brain substance more than four millimetres square, unsearched.

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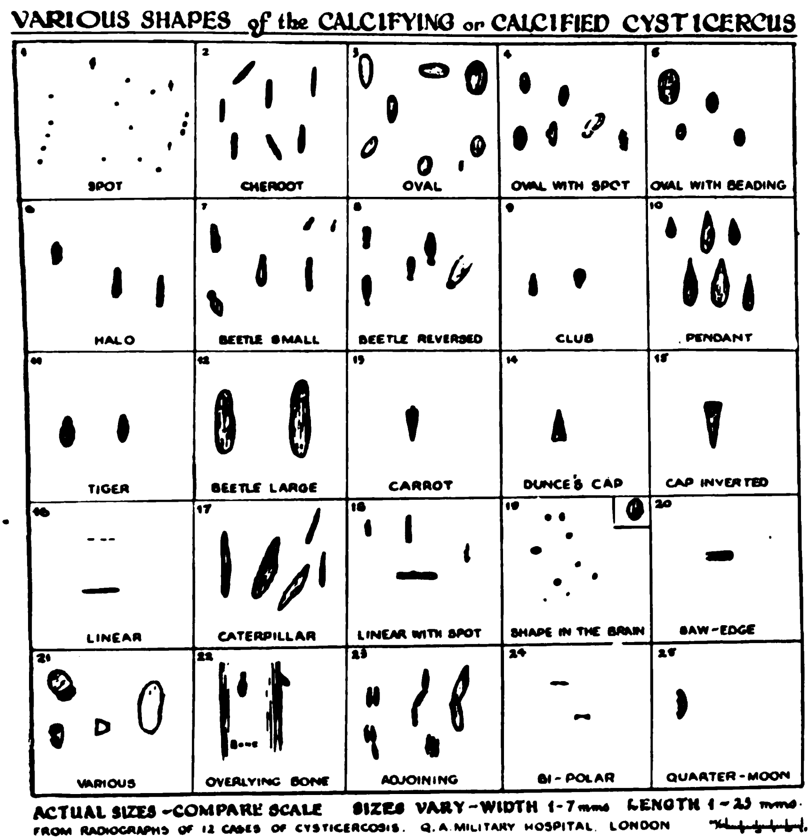
[1] I am indebted to Major Morrison for the following notes on X-ray examination:—

"For routine investigation the following regions are radiographed—skull, lateral view only; root of neck; upper arms; fore-arms; thighs; legs. The films and the intensifying screens should be free from "grain." The Potter-Bucky diaphragm is used only for the skull radiograph. The standard of radiograph aimed at in each region should be that of the ordinary exposure conditions for bone detail, with a very slight under-exposure. It is useless to take the radiograph under special conditions to show soft tissues only.

"The parasite may be represented by a final radiopacity in any form from the calcified scolex (about one millimetre in diameter) up to a fully-grown elliptical cyst (about twenty-three millimetres long). Radiographs are viewed in the ordinary way, but owing to the faint shadow produced by the early calcifying parasite, the search of the soft tissues must be a very thorough one. It is quite easy to miss a small section of a calcified parasite at the upper or lower margins of the films, or to miss one overlying normal bone shadows. Oblique illumination is sometimes of value. If single shadows are observed, the patient's skin should be examined for the presence of warts, scars, or red ink tattoo marks. The shadows often imitate simple film stains, and in case of doubt the radiograph should be repeated. Films should be filed for comparison with those taken at a later date."

It is scarcely necessary to add that the radiologist should familiarize himself with the structure of cysticerci and their developmental history in the body.

Though it may seem incredible to members of a scientific society, I have been asked what is the good of "going to all this trouble" to establish a diagnosis of cysticercosis when little or nothing can be done for the sufferer. There is one obvious advantage to a soldier, for the disease when acquired abroad is rightly held to be attributable to military service. Apart



[*From the "British Medical Journal*, 1934, *Jan.* 6, *p.* 14.]

from this material gain there are other advantages. Men labelled as epileptics, and labelled wrongly as was proved later, have protested, literally with tears in their eyes, that epilepsy was unheard of in their families, and have asked with dismal forebodings whether the disease would show itself in their children. Further, when mental deterioration has advanced so far that the subject becomes certifiable as insane, it is an indescribable relief to all his family and connexion—even though the unfortunate victim himself may gain no benefit—to know that the slur of familial lunacy has been removed.

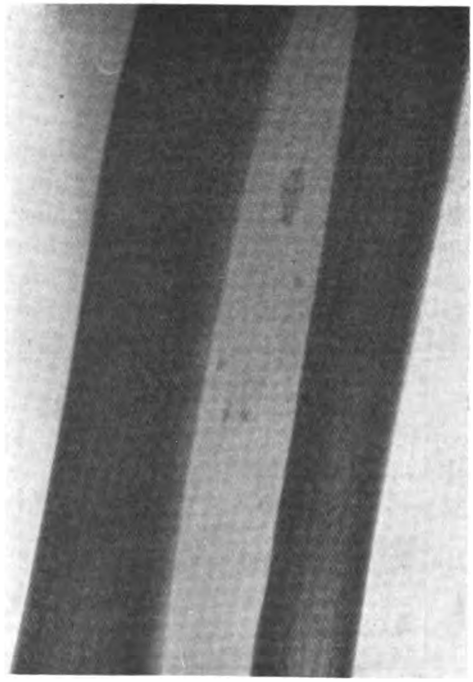


Fig. 1.—One calcified cyst and several calcified scolices. (Eight years after removal of unidentified tapeworm, 6 years after first nodule detected, and 4 years after initial fit). A +; B +.

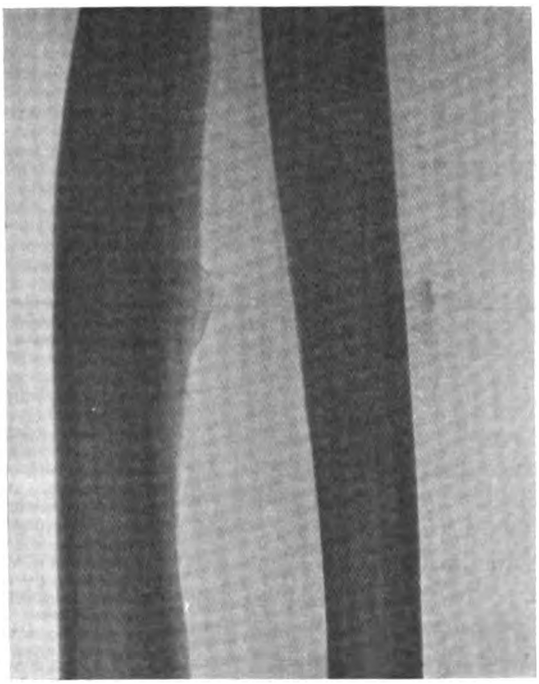


Fig. 2.—Two calcifying cysts. (Seven years after initial fit, and three years after first nodule; no tapeworm). A +; B −.

A + = Cysticercus excised and identified. B + = Complement-fixation and skin tests positive.
B − = Complement fixation and skin tests negative.

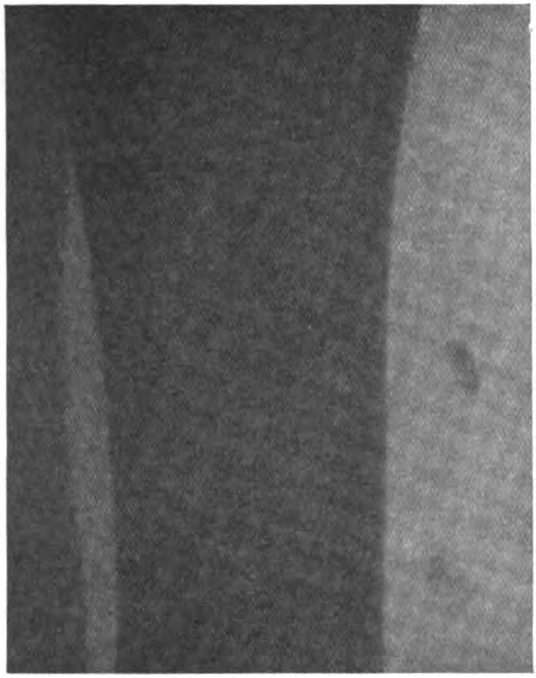


FIG. 3.—Two calcifying cysts. (Six years after initial fit; no nodules detected; no tapeworm.) B —.

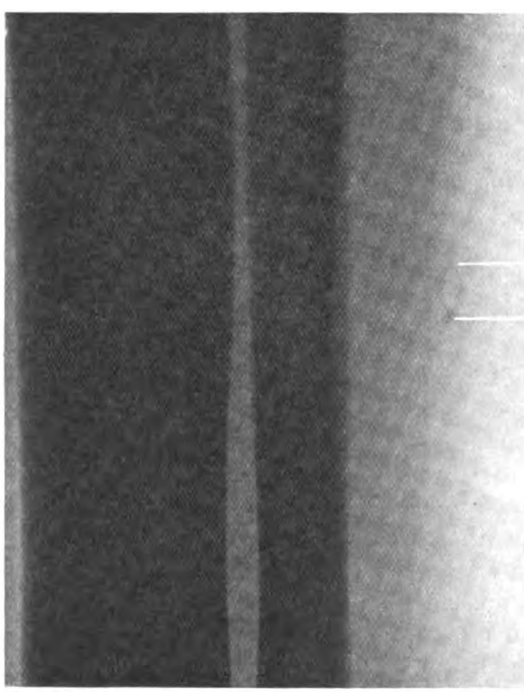


FIG. 4.—A calcareous scolex, presumably free, at lower extremity of calcifying cyst. (Same year as initial fit, but the appearance of the parasite shows that infestation has lasted for several years; subcutaneous lipomata rendered search for palpable cysts ineffective; no tapeworm.) B +.

B — = Complement-fixation and skin tests negative. B + = Complement-fixation and skin tests positive.

Prognosis.

Prognosis in this disease is a matter of extreme difficulty for there is no method of ascertaining during life the number of cysticerci and their distribution in the brain, or of forecasting the vagaries of their future behaviour on which so much depends. The most dangerous time is from the sixth to the eighth year for then the grave intensification of existing cerebral disturbances most frequently takes place, and subjects who have remained free from outward signs of extensive brain involvement are most likely to show them about this time.

The general tendency is one of retrogression, as evidenced by signs of mental deterioration which may be so marked as to necessitate institutional segregation. On the other hand, some patients in spite of persisting epilepsy remain mentally alert; while in four of the series, fits have ceased after a duration which ranged from a few months to twenty years.

Treatment.

The luminal and bromide series are sometimes helpful in controlling fits, but no medicinal treatment so far employed has had any curative effect. Indeed the observations on tissue changes which follow the death of intracerebral cysticerci suggest that the destruction of large numbers of these parasites at the same time—supposing that some chemical of lethal power were forthcoming—might only make matters worse for the sufferer. Of two men who received intravenous injections of antimony tartrate, one developed a crop of "new" cysts afterwards, while in the other, the cysts already present increased in size and the cerebral symptoms became aggravated. These results cannot be attributed to treatment, for similar phenomena are commonly seen in untreated patients, but they are such as would be expected to follow the administration of a parasiticidal drug, unless, possibly, this were employed very early in the course of an infestation before the embryo had attained larval maturity.

The large numbers of parasites found in the brain and their wide distribution there do not encourage a general resort to surgery. The successful removal of cerebral cysts is reported occasionally in the medical press, but before claiming a cure or appraising the degree of permanent improvement, time must be given for any other parasites in the brain to die off, and this may mean years of observation. In actual practice a temporary amelioration of symptoms after removal of one or more cysts has been followed by the death of the patient in status epilepticus.

I should not favour operation except when some restricted and constant localizing sign is present (e.g. aphasia). It is important to remember that muscular spasm if confined to some particular part during a single fit does not necessarily indicate a limited cortical involvement, for when an individual patient is watched in a series of several fits, each of them may be observed to affect a different group of muscles.

The possible extent of indigenous cysticercosis in England is unknown,

for no one has yet searched for the disease. That it can be contracted here is shown by one of our cases, a man who has never left this country. Intestinal infestation by *T. solium* contracted in England is believed to be rare to-day, but there is always a possibility of infested persons returning from abroad, and recently I heard of a man resident for over four years in

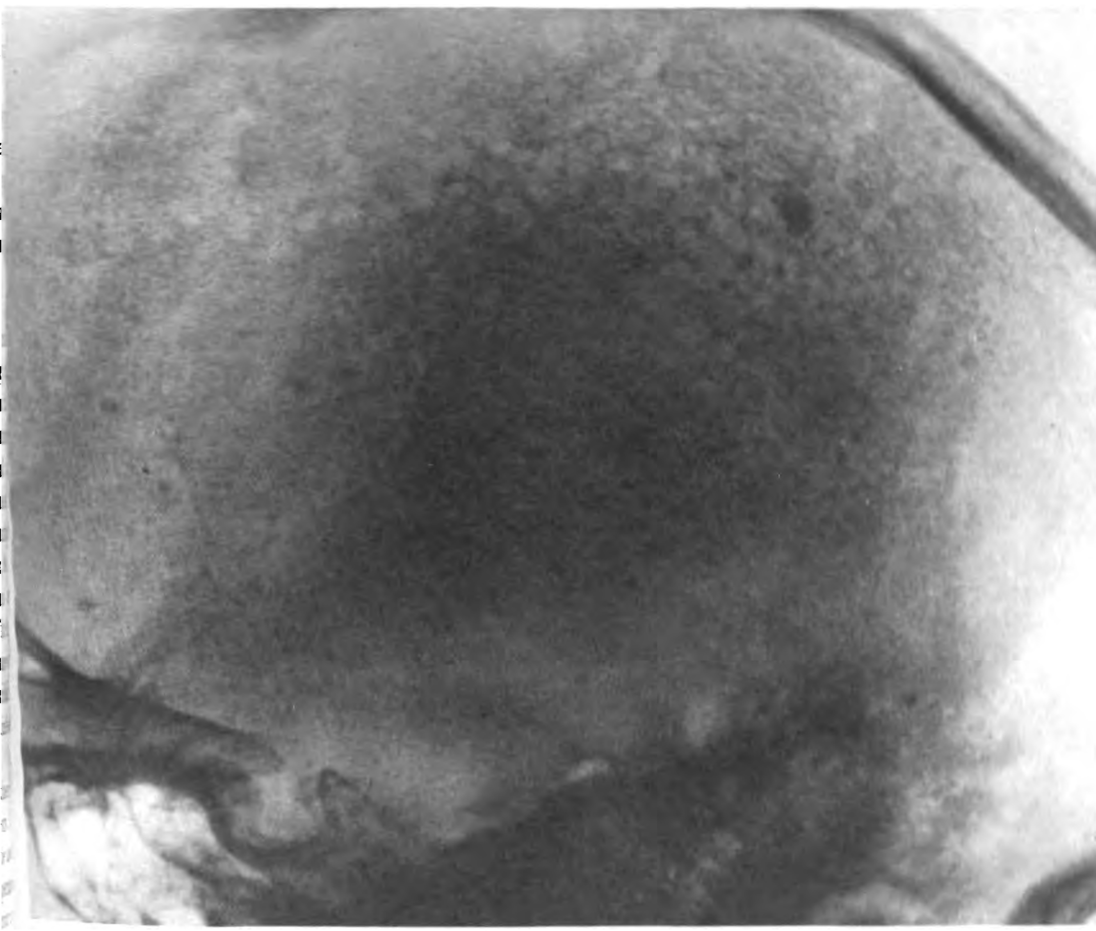


FIG. 5.—One calcified cyst and many calcified scolices in brain. Of twenty-six patients who showed calcified parasites somewhere in the body, positive radiographs of the brain were obtained in five. Calcification in the brain, when it occurs, appears to affect mainly the scolex, and sixty-six cerebral parasites out of seventy-one detected in films showed the scolex type of calcification.

a country district in England, who has been passing segments of *T. solium* throughout this period. To intensify this risk of chance infestation there is a common practice in rural England, as I recently learned to my amazement, of using human dejecta as a fertilizer for vegetable gardens and fields. But apart from the possibility of home-acquired cysticercosis, there are many people in Great Britain who have been exposed to a risk of

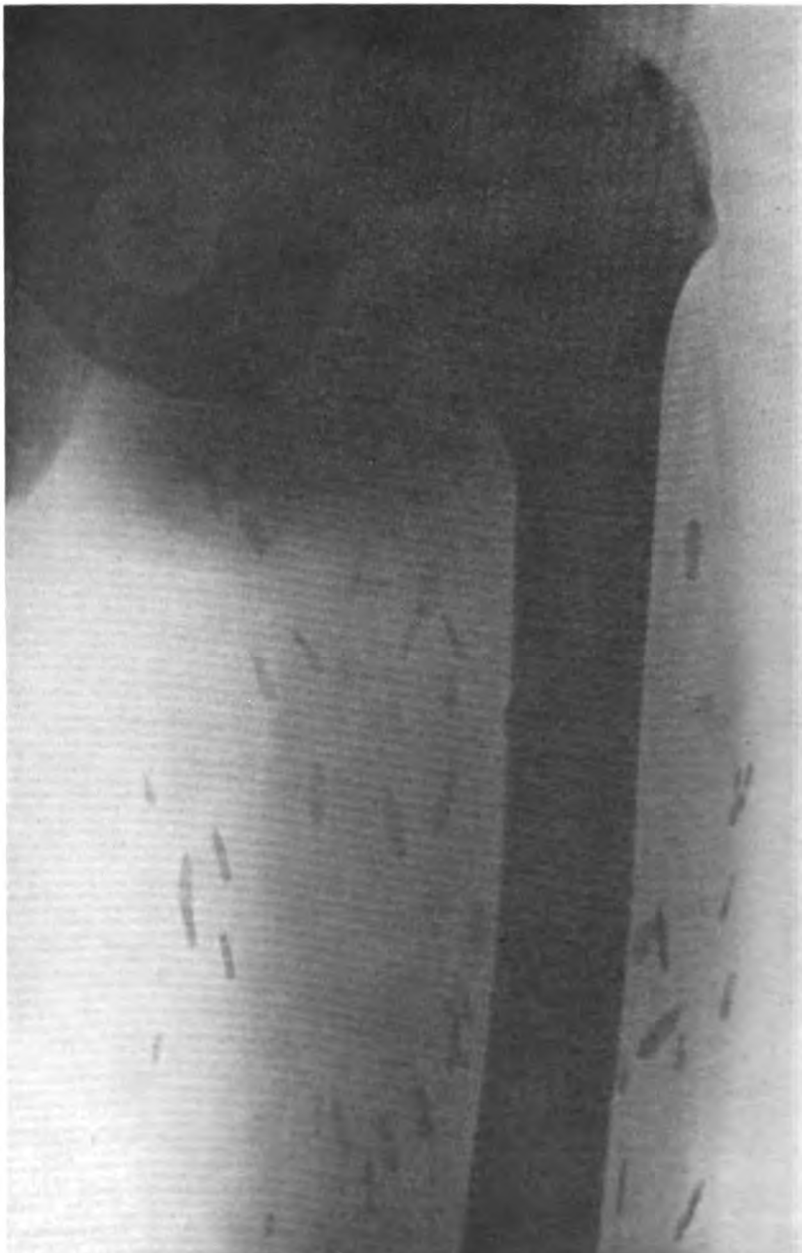


FIG. 6.—Although this type of calcification is well known, the radiograph is included because of the patient's history: Aged 40, served in India 1913-20, Egypt 1920-23; has not left England since 1923. No tapeworm; "never had a day's illness." In October, 1932, had a major epileptic fit, followed by a second in 1933, which was witnessed, and certified as "true epilepsy." The condition shown above is general throughout body. No nodules, and none noticed at any time. Duration of infestation unknown, but clearly it has existed for many years.

[*This and the preceding plates are from radiographs provided by the Queen Alexandra Military Hospital, Millbank, London.*]

contamination abroad—discharged soldiers and sailors of the regular forces, the tens of thousands who served abroad during the late war, civilians who follow their avocations beyond the seas, and, of late, the crowds of tourists who explore tropical countries with a zeal undamped by any knowledge of preventive medicine. I should like to enlarge somewhat on the group mentioned first, in case my words may reach the general practitioner. Our experience suggests that there are many undiscovered sufferers from cysticercosis among army reservists and discharged soldiers. Men who develop fits after leaving the Army hide their disability and deny it if questioned, for they live in dread of losing their few weekly shillings of reservists' pay. Fits to them mean epilepsy, and they know that (true) epilepsy as a "constitutional" disease is regarded as not attributable to military service. Several ex-soldiers who had lost job after job because of "fits"—one of them an inmate of a workhouse—made despairing appeals *ad misericordiam*, and have been found to be victims of cysticercosis. There must be many others throughout the country.

Our investigation gives at least some indication of the serious extent of cysticercosis in the Army. It is not a military disease in any sense, and there is nothing in the ordinary life of a soldier to render him more likely to contract infestation than other persons resident in the countries where British troops serve. Of these, we know that the disease has originated in India, Egypt and Malaya, and probably in other countries as well, but because of changes of station during the long presymptomatic period so commonly present, it is often impossible to say where the disease was contracted. I see no reason to suppose that the European civilians in these countries are entirely exempt from attack.

If a commission of persons who have studied this disease, especially in its more elusive forms, were to search diligently in lunatic asylums, institutions for epilepsy, and general hospitals, I think that the results would be surprising. If such an inquisition did not bring to light hundreds of unsuspected cases of cysticercosis, I should regard this as the greatest miracle since Moses smote the rock.

[We regret that owing to limitations of space we are unable to reprint the discussion which followed Colonel MacArthur's paper.—Ed.]

AIR AMBULANCES.

By Colonel E. M. COWELL, D.S.O., D.L., M.D. F.R.C.S
Territorial Army.

I. Introduction.

This paper was read before the United Services Section of the Royal Society of Medicine in December, 1933.

In introducing the subject of Medical Air Transport, much of the ground covered may be familiar to many. Most of the facts have already been published, and the subject has been fully dealt with in reports issued by the International Congress of Aviation Sanitaire of 1929, and in subsequent proceedings of conferences held in Paris, under the auspices of the League of International Red Cross Societies.

The subject of Air Medical Transport was first brought acutely to the writer's notice by Major-General P. H. Henderson, D.S.O., K.H.P., in a lecture at the Services Section of the Royal Society of Medicine in April, 1931.

In that lecture it was pointed out that, in this country, we had as yet no organized Medical Transport Service for use in case of war or civil emergencies.

Financial considerations, together with a shortage of Royal Air Force Flying Officers, render a Service Medical Transport scheme impossible, at any rate at present.

The difficulty has been overcome by collecting a voluntary flying personnel, organized by the British Red Cross Society and sanctioned by the Air Ministry.

In case of need, volunteers will be called for and mobilized as required. As will be shown later, Air Ambulance Detachments now exist in Great Britain, consisting of a personnel of highly experienced pilots, men and women, trained in First Aid and also in the special task of transporting casualties by air.

II. Historical Review.

Probably the first reference in literature to the subject was by that wonderful prophet, Jules Verne, who in his book, "Robur le Conquérant," describes the rescue of shipwrecked men by an airship "the Albatros."

From 1890 to 1911, M. de Mooy, a Dutch doctor, was working at medical aviation both with balloons and aeroplanes.

Mlle. Marvingt, a medical student and aviator was his colleague, and proposed plans for air ambulance work of a military nature. From this date onwards the French have taken the keenest interest in "Aviation Sanitaire."

In 1913 at the Société de Médecine Militaire, M. Uzac read an

exhaustive paper, and M. Julliot advocated protection of the machines by the Geneva Cross.

In 1915 successful air evacuations were made by the French in Albania. In the Great War casualties were too numerous and machines too few and not suited for transporting wounded by air.

However, towards the end of the War, in 1917, Dr. Chassaing, working with M. Justin Godart, designed a lateral opening to enable two superimposed stretchers to be carried in the "dead space" of the fuselage.

Subsequently in the fighting in Morocco and Syria Medical Air Transport began to be used.

The value of this service was recognized by Marshal Lyautey, and under the direction of Colonel Cheutin, the 37th Regiment of Aviation carried more than 1,050 wounded in the first ten months of 1923.

Here, a new type of machine was introduced called the *Aerochir*, to enable the surgeon and his team to proceed direct to a casualty and operate on the Field.

The use of such an outfit is however not of great value. All agree it is better to operate on casualties after they have been moved into the safety and comfort of a hospital.

For transporting wounded it was found that two types of machine were necessary. (1) The large Breguet-Limousine, capable of carrying eight to ten cases, and (2) the small Hanriot biplane, carrying one or two stretcher cases besides the pilot. The latter requires but little landing space and can be operated in difficult country. In the next two years more than 4,000 casualties were evacuated by air in Morocco.

General Denain reported that following fighting on the "Euphrates," eighty severely wounded were carried by air, in the space of two days, to the base hospital 400 kilometres (250 miles) away. This journey occupied four hours as against five days by motor ambulance, or fifteen days by mule transport, through desert country threatened by hostile tribes.

III. (A.) Details of Air Medical Transport used by the French (Military).

Special air ambulance machines were first used in Morocco, where it had been foreseen that this method of evacuation would be useful in desert warfare.

In September, 1918, eighteen wounded were carried from Tafilalet to Bou-Denib. After this, the service was gradually developed. It was reported that the early pilots were not keen and did not manifest excessive zeal for this work.

The first machines were not very successful, but in 1920 twenty machines were provided for Morocco and sixteen for the Levant.

In 1921 these machines arrived in Morocco; they were the Hanriot type with two stretchers carried superimposed in the fuselage and loaded by means of a lateral porthole.

From 1921 to 1928, 3,969 cases were carried with two fatal accidents, both incurred when the machines were taking off. Picked pilots were always chosen, with at least 400 hours flying experience and training in medical transport. It has been observed that although the pilots do this work as part of their general duties, they generally prefer their fighting missions. The large machines were not favoured by the pilots and the small Hanriots (H 13-S) were generally used.

It was found by experience that the Chassaing arrangement was not very roomy, although comfortable. Also that the tendency for the patient to slip off the stretcher had to be met by the provision of sheepskin bags.

Severe fractures with splints could not be carried in the smaller machines, and the patient was worried by the absence of visibility.

The larger Breguet-Limousine type is excellent but difficult to load, since a special stretcher is required. A very large door is needed for loading the standard stretcher.

The casualties were generally sent unaccompanied. In January, 1929, the Moroccan Air Medical Service consisted of twenty-six Breguet machines and seventeen Hanriots.

In the Levant from 1921 to 1928, 1,392 evacuations were carried out. Here also a careful preliminary organization was found to be necessary. Depots were arranged with adequate supplies of equipment and stores, in charge of engineer-officers and mechanics. Suitable landing places were chosen and the surface of the ground well prepared.

Arrangements were made for wireless communication, so that on the receipt of a message from a reconnoitring column an ambulance machine could be sent out at once.

In one series of fifty cases carried in the Levant by the Breguet machines, seven died later, but none were reported on arrival as having suffered from the journey.

(B) General Considerations of Military Medical Air Transport.

It is a surgical axiom that in order to save life serious cases must be operated on in from four to twelve hours, less serious in under twenty-four hours and the other cases within thirty-six hours. The sooner the lightly wounded man is treated, the sooner he can be returned to duty.

It is generally agreed that in view of the existence of long-range guns, wounded must be treated at least twenty to thirty miles behind the firing line.

It is possible to do major operations close to the firing line in well protected dug-outs, but such cases do badly, will not stand evacuation, and, moreover, casualties must be cleared early, otherwise the movements of the fighting troops may be hampered, quite apart from the question of morale.

The technical medical personnel is best employed further back. Front line treatment should consist of efficient first-aid and rapid evacuation.

The French authorities estimate that a division engaged in active major operations will sustain 600 casualties a day, and of these 17 per cent will be serious cases requiring air transport. It is found that 4 per cent of these cases will be of the first urgency, and 13 per cent of the second urgency. The daily air evacuations will therefore total 102 cases.

The range of action of an air ambulance is about 300 miles, three hours' flight. A machine can make 2 to 3 trips in the summer or 3 to 4 trips if night flying is allowed. From this it follows that an establishment of 2 to 3 large ambulance machines per division is required.

As regards the limit of safety for the forward landing grounds, it is considered that no site less than ten kilometres (about six miles) behind the front line must be thought of. This is in the area of Corps Headquarters, where the danger of shell fire is less and where the ground can be marked by protecting signs.

These forward landing grounds will be organized as Air Collecting Stations, chosen by an Air Force Officer working in liaison with an R.A.M.C. Officer. Motor Transport or wheeled stretchers will be required and a careful selection of cases will be made by an experienced officer.

The Air Collecting Stations must be in communication by wireless with the base from which the air ambulances are coming.

(C) Civil Use of Air Ambulances.

The French colonial authorities have organized an extensive Air Ambulance Service.

It is considered that colonists have a greater sense of security, when they know that in case of illness, they or members of their families can be rapidly transported to hospital.

The first essential is the provision of landing grounds, adequate and plentiful. Secondly, the machine employed must be a good flyer, capable of taking off and landing in a minimal space. It must be able to carry a stretcher, doctor or orderly, and a relative. The cabin must be closed, heated and ventilated. For long journeys wireless should be installed.

The Swedish Red Cross have run an Air Ambulance Service since 1924 most successfully.

In Australia an Inland Air Mission is functioning and has been the means of saving many lives.

Italy, Poland, and many other countries have successful air ambulance organizations.

IV. Physiological and Psychological Effects of Air Transport on Casualties.

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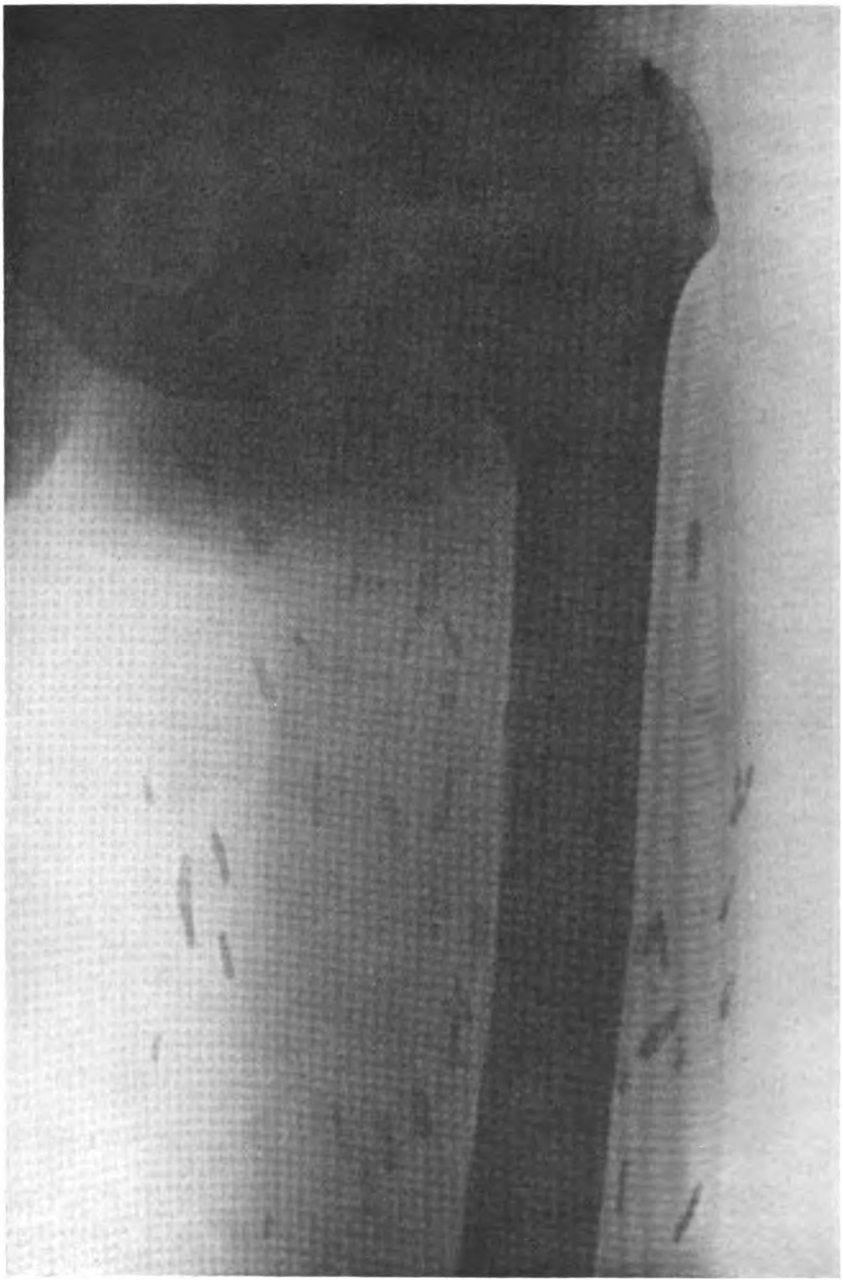

FIG. 6.—Although this type of calcification is well known, the radiograph is included because of the patient's history: Aged 40, served in India 1913-20, Egypt 1920-23; has not left England since 1923. No tapeworm; "never had a day's illness." In October, 1932, had a major epileptic fit, followed by a second in 1933, which was witnessed, and certified as "true epilepsy." The condition shown above is general throughout body. No nodules, and none noticed at any time. Duration of infestation unknown, but clearly it has existed for many years.

[This and the preceding plates are from radiographs provided by the Queen Alexandra Military Hospital, Millbank, London.]

contamination abroad—discharged soldiers and sailors of the regular forces, the tens of thousands who served abroad during the late war, civilians who follow their avocations beyond the seas, and, of late, the crowds of tourists who explore tropical countries with a zeal undamped by any knowledge of preventive medicine. I should like to enlarge somewhat on the group mentioned first, in case my words may reach the general practitioner. Our experience suggests that there are many undiscovered sufferers from cysticercosis among army reservists and discharged soldiers. Men who develop fits after leaving the Army hide their disability and deny it if questioned, for they live in dread of losing their few weekly shillings of reservists' pay. Fits to them mean epilepsy, and they know that (true) epilepsy as a "constitutional" disease is regarded as not attributable to military service. Several ex-soldiers who had lost job after job because of "fits"—one of them an inmate of a workhouse—made despairing appeals *ad misericordiam*, and have been found to be victims of cysticercosis. There must be many others throughout the country.

Our investigation gives at least some indication of the serious extent of cysticercosis in the Army. It is not a military disease in any sense, and there is nothing in the ordinary life of a soldier to render him more likely to contract infestation than other persons resident in the countries where British troops serve. Of these, we know that the disease has originated in India, Egypt and Malaya, and probably in other countries as well, but because of changes of station during the long presymptomatic period so commonly present, it is often impossible to say where the disease was contracted. I see no reason to suppose that the European civilians in these countries are entirely exempt from attack.

If a commission of persons who have studied this disease, especially in its more elusive forms, were to search diligently in lunatic asylums, institutions for epilepsy, and general hospitals, I think that the results would be surprising. If such an inquisition did not bring to light hundreds of unsuspected cases of cysticercosis, I should regard this as the greatest miracle since Moses smote the rock.

[We regret that owing to limitations of space we are unable to reprint the discussion which followed Colonel MacArthur's paper.—ED.]

AIR AMBULANCES.

By Colonel E. M. COWELL, D.S.O., D.L., M.D. F.R.C.S
Territorial Army.

I. Introduction.

This paper was read before the United Services Section of the Royal Society of Medicine in December, 1933.

In introducing the subject of Medical Air Transport, much of the ground covered may be familiar to many. Most of the facts have already been published, and the subject has been fully dealt with in reports issued by the International Congress of Aviation Sanitaire of 1929, and in subsequent proceedings of conferences held in Paris, under the auspices of the League of International Red Cross Societies.

The subject of Air Medical Transport was first brought acutely to the writer's notice by Major-General P. H. Henderson, D.S.O., K.H.P., in a lecture at the Services Section of the Royal Society of Medicine in April, 1931.

In that lecture it was pointed out that, in this country, we had as yet no organized Medical Transport Service for use in case of war or civil emergencies.

Financial considerations, together with a shortage of Royal Air Force Flying Officers, render a Service Medical Transport scheme impossible, at any rate at present.

The difficulty has been overcome by collecting a voluntary flying personnel, organized by the British Red Cross Society and sanctioned by the Air Ministry.

In case of need, volunteers will be called for and mobilized as required. As will be shown later, Air Ambulance Detachments now exist in Great Britain, consisting of a personnel of highly experienced pilots, men and women, trained in First Aid and also in the special task of transporting casualties by air.

II. Historical Review.

Probably the first reference in literature to the subject was by that wonderful prophet, Jules Verne, who in his book, "Robur le Conquérant," describes the rescue of shipwrecked men by an airship "the Albatros."

From 1890 to 1911, M. de Mooy, a Dutch doctor, was working at medical aviation both with balloons and aeroplanes.

Mlle. Marvingt, a medical student and aviator was his colleague, and proposed plans for air ambulance work of a military nature. From this date onwards the French have taken the keenest interest in "Aviation Sanitaire."

In 1913 at the Société de Médecine Militaire, M. Uzac read an

exhaustive paper, and M. Julliot advocated protection of the machines by the Geneva Cross.

In 1915 successful air evacuations were made by the French in Albania. In the Great War casualties were too numerous and machines too few and not suited for transporting wounded by air.

However, towards the end of the War, in 1917, Dr. Chassaing, working with M. Justin Godart, designed a lateral opening to enable two superimposed stretchers to be carried in the "dead space" of the fuselage.

Subsequently in the fighting in Morocco and Syria Medical Air Transport began to be used.

The value of this service was recognized by Marshal Lyautey, and under the direction of Colonel Cheutin, the 37th Regiment of Aviation carried more than 1,050 wounded in the first ten months of 1923.

Here, a new type of machine was introduced called the *Aerochir*, to enable the surgeon and his team to proceed direct to a casualty and operate on the Field.

The use of such an outfit is however not of great value. All agree it is better to operate on casualties after they have been moved into the safety and comfort of a hospital.

For transporting wounded it was found that two types of machine were necessary. (1) The large Breguet-Limousine, capable of carrying eight to ten cases, and (2) the small Hanriot biplane, carrying one or two stretcher cases besides the pilot. The latter requires but little landing space and can be operated in difficult country. In the next two years more than 4,000 casualties were evacuated by air in Morocco.

General Denain reported that following fighting on the "Euphrates," eighty severely wounded were carried by air, in the space of two days, to the base hospital 400 kilometres (250 miles) away. This journey occupied four hours as against five days by motor ambulance, or fifteen days by mule transport, through desert country threatened by hostile tribes.

III. (A.) Details of Air Medical Transport used by the French (Military).

Special air ambulance machines were first used in Morocco, where it had been foreseen that this method of evacuation would be useful in desert warfare.

In September, 1918, eighteen wounded were carried from Tafilalet to Bou-Denib. After this, the service was gradually developed. It was reported that the early pilots were not keen and did not manifest excessive zeal for this work.

The first machines were not very successful, but in 1920 twenty machines were provided for Morocco and sixteen for the Levant.

In 1921 these machines arrived in Morocco; they were the Hanriot type with two stretchers carried superimposed in the fuselage and loaded by means of a lateral porthole.

From 1921 to 1928, 3,969 cases were carried with two fatal accidents, both incurred when the machines were taking off. Picked pilots were always chosen, with at least 400 hours flying experience and training in medical transport. It has been observed that although the pilots do this work as part of their general duties, they generally prefer their fighting missions. The large machines were not favoured by the pilots and the small Hanriots (H 13-S) were generally used.

It was found by experience that the Chassaing arrangement was not very roomy, although comfortable. Also that the tendency for the patient to slip off the stretcher had to be met by the provision of sheepskin bags.

Severe fractures with splints could not be carried in the smaller machines, and the patient was worried by the absence of visibility.

The larger Breguet-Limousine type is excellent but difficult to load, since a special stretcher is required. A very large door is needed for loading the standard stretcher.

The casualties were generally sent unaccompanied. In January, 1929, the Moroccan Air Medical Service consisted of twenty-six Breguet machines and seventeen Hanriots.

In the Levant from 1921 to 1928, 1,392 evacuations were carried out. Here also a careful preliminary organization was found to be necessary. Depots were arranged with adequate supplies of equipment and stores, in charge of engineer-officers and mechanics. Suitable landing places were chosen and the surface of the ground well prepared.

Arrangements were made for wireless communication, so that on the receipt of a message from a reconnoitring column an ambulance machine could be sent out at once.

In one series of fifty cases carried in the Levant by the Breguet machines, seven died later, but none were reported on arrival as having suffered from the journey.

(B) General Considerations of Military Medical Air Transport.

It is a surgical axiom that in order to save life serious cases must be operated on in from four to twelve hours, less serious in under twenty-four hours and the other cases within thirty-six hours. The sooner the lightly wounded man is treated, the sooner he can be returned to duty.

It is generally agreed that in view of the existence of long-range guns, wounded must be treated at least twenty to thirty miles behind the firing line.

It is possible to do major operations close to the firing line in well protected dug-outs, but such cases do badly, will not stand evacuation, and, moreover, casualties must be cleared early, otherwise the movements of the fighting troops may be hampered, quite apart from the question of morale.

The technical medical personnel is best employed further back. Front line treatment should consist of efficient first-aid and rapid evacuation.

The French authorities estimate that a division engaged in active major operations will sustain 600 casualties a day, and of these 17 per cent will be serious cases requiring air transport. It is found that 4 per cent of these cases will be of the first urgency, and 13 per cent of the second urgency. The daily air evacuations will therefore total 102 cases.

The range of action of an air ambulance is about 300 miles, three hours' flight. A machine can make 2 to 3 trips in the summer or 3 to 4 trips if night flying is allowed. From this it follows that an establishment of 2 to 3 large ambulance machines per division is required.

As regards the limit of safety for the forward landing grounds, it is considered that no site less than ten kilometres (about six miles) behind the front line must be thought of. This is in the area of Corps Headquarters, where the danger of shell fire is less and where the ground can be marked by protecting signs.

These forward landing grounds will be organized as Air Collecting Stations, chosen by an Air Force Officer working in liaison with an R.A.M.C. Officer. Motor Transport or wheeled stretchers will be required and a careful selection of cases will be made by an experienced officer.

The Air Collecting Stations must be in communication by wireless with the base from which the air ambulances are coming.

(C) Civil Use of Air Ambulances.

The French colonial authorities have organized an extensive Air Ambulance Service.

It is considered that colonists have a greater sense of security, when they know that in case of illness, they or members of their families can be rapidly transported to hospital.

The first essential is the provision of landing grounds, adequate and plentiful. Secondly, the machine employed must be a good flyer, capable of taking off and landing in a minimal space. It must be able to carry a stretcher, doctor or orderly, and a relative. The cabin must be closed, heated and ventilated. For long journeys wireless should be installed.

The Swedish Red Cross have run an Air Ambulance Service since 1924 most successfully.

In Australia an Inland Air Mission is functioning and has been the means of saving many lives.

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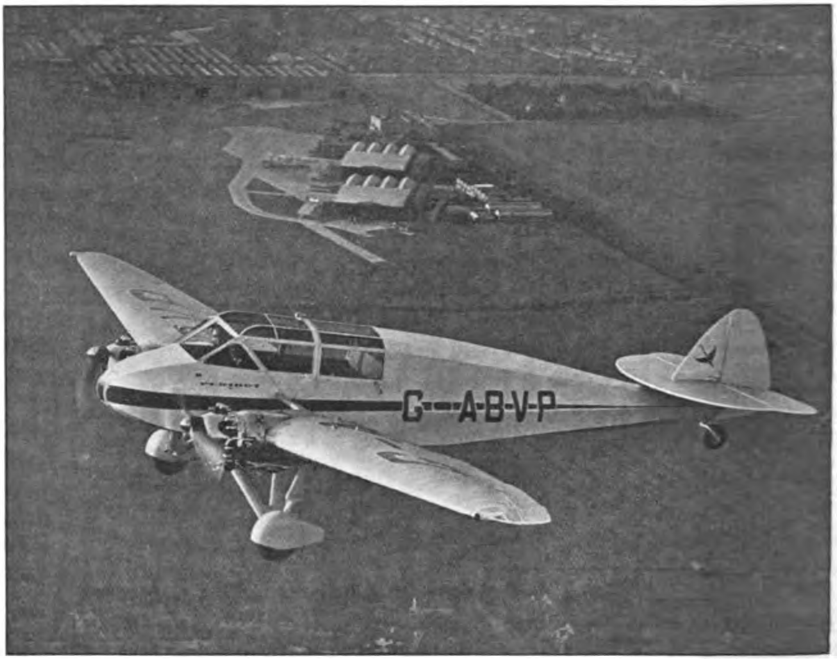


[*Reproduced by kind permission, from "Flight."*]

FIG. 1.—Loading by means of a large lateral flap on each side of the cabin.

[*Reproduced by kind permission from "Proceedings of a Round Table Conference on Air Ambulance Services, 1933."*]

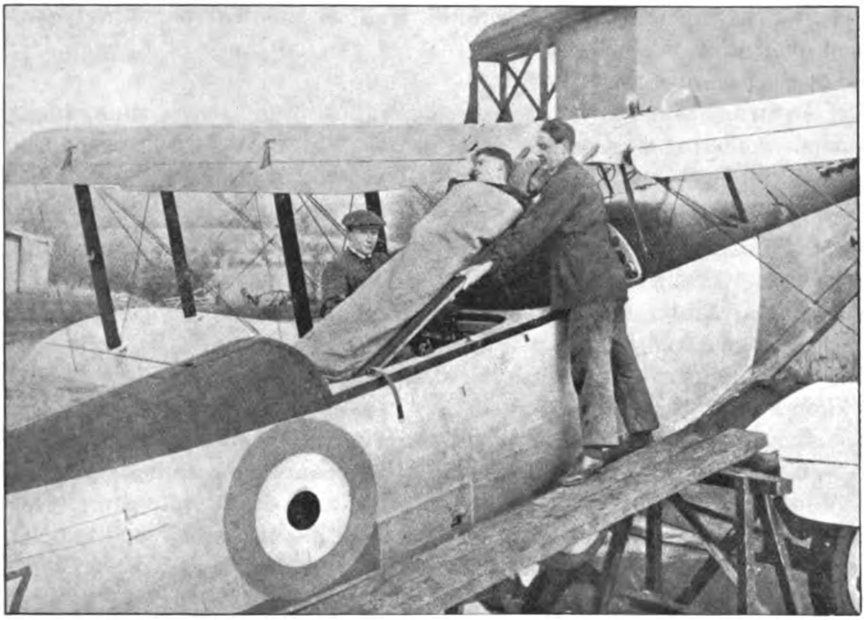
FIG. 2.—Loading the Puss Moth. Patient on the Neil-Robertson stretcher.

would take two stretchers. Loading was done through the port window and the patient had to be put on the Neil-Robertson stretcher.

The de Havilland Puss Moth can also carry stretchers in the same way, but it is not ideal for the purpose (fig. 2).

The Dragon Moth affords a suitable type machine of the larger class and will carry six to eight cases. Fig. 3 shows a stretcher being loaded into a Service machine. The method is not very practical.

Imperial Airways have kindly allowed me to look over their big machines of the Hercules type.



[*Reproduced by kind permission from "Proceedings of a Round Table Conference on Air Ambulance Services,* 1933."]

FIG. 3.—A military plane. Aircraft convertible into ambulance planes.

There are two large cabins each capable of being fitted with fourteen Army pattern stretchers. In addition a medical officer, four to six orderlies, and stores can be carried.

In order to get over the difficulty of loading through the narrow door and the very narrow corridor connecting the fore and aft cabins, it is necessary to apply an attachment to the ordinary Service pattern stretcher.

With the assistance of Mr. Basil Monk of the Trojan Engineering Company, I am working at the question of adapting the Service pattern stretcher for loading through a narrow door. A method has been successfully evolved, and will be published at a later date.

The French and Dutch machines used in commercial aviation are easily convertible into large ambulances.

VII.—Air Transport for Naval Casualties.

This question has been explored, but at present no practical conclusions have been arrived at. Theoretically an air ambulance machine of the autogiro type could possibly be carried on a warship, or aeroplane carriers could be allotted for ambulance purposes, and hospital ships be fitted to receive machines.

Practical considerations, however, do not allow of this.

Summary.

(1) In peace time the value of air medical transport is great. Special medical stores, vaccines and serum as well as medical personnel can be rushed over great distances to the seat of the outbreak of any epidemic, disease or calamity.

(2) In war time, the smooth, easy, rapid flight saves time, life and suffering. Clearing stations will be largely eliminated and surgeons can save life and limb.

Conclusions.

The following eight conclusions drawn up in the French report published in 1929 are so excellent that they may be quoted in full :—

(1) An Air Ambulance Service must be considered as a normal means of transport in a modern war.

(2) It seems hardly probable that the machine could approach within ten kilometres from the front.

(3) It should serve the base hospitals 150 to 200 kilometres back.

(4) The medium and large size machines seem alone to be useful.

(5) Light machines are not recommended to carry from the front to landing grounds for large machines. It would be different for autogiros.

(6) An air ambulance machine should have a mean speed of 175 kilometres per hour and a range of 500 kilometres.

(7) They will be provided by requisition of civil machines or manufactured in time of war.

(8) Civil aviation (commercial) can easily and with advantage be transformed into an Air Ambulance Service.

(9) This Service should constitute a special section of the Air Force.

(10) The Service should be placed in general reserve, to be drawn on by the armies as required.

(11) International Red Cross can usefully intervene in bringing the subject to the Convention of Geneva and in recruiting pilots.

HÆMOGLOBINURIA: A NEW PROBLEM ON THE INDIAN FRONTIER.

By Lieutenant-Colonel A. C. AMY, D.S.O.,
Royal Army Medical Corps.

(*Continued from p.* 191.)

Certain Indications of Blackwater Fever and of Plasmoquine Poisoning.

Having dealt with causes, it now remains to say a few words regarding effects—necessarily confining the discussion (as before) to those points which have a bearing on the ten cases now before us; and especially to those points which caused some of our cases so strikingly to resemble blackwater fever.

In Blackwater Fever.

(1) The attack is usually ushered in with a severe rigor and sudden hyperpyrexia.

(2) There is often a relatively high large mononuclear leucocyte count; in India, about 4 per cent is regarded as normal. But, even in health, percentages as high as 15 and 20 have been observed. However, in this connection, Ross [35] says that Stephens and Christophers (1900) and Christophers and Bentley (1908) have drawn attention to the very definite increase of mononuclears in this disease, and their work has received confirmation by subsequent investigators. In an examination of 38 cases in Rhodesia, in 8 cases the percentage of large nuclears was below 10 per cent; in 20 cases between 10 and 20 per cent; in 8 cases between 20 and 30 per cent; and in 2 over 30 per cent. It seems likely that part of this mononuclear increase is dependent upon reaction to blood destruction. Ross is of opinion that it does not seem justifiable to draw any conclusion regarding the ætiology of the condition from this increase in the mononuclear count; and he goes on to say that: "While changes in the leucocyte picture do occur in blackwater fever, there is no definite or characteristic feature that may be said to typify the condition, nor does there seem to be any hope that a study of such changes will lead to a fuller understanding of the ætiology of the disease."

The subject of hæmoglobinæmia-hæmoglobinuria has already been mentioned. In the present series, 2 cases of oxyhæmoglobinuria and 5 of methæmoglobinuria were reported; the remaining 3 were merely returned as "Hæmoglobinuria."

(3) The Urine.—Absence of bile-pigments and salts conforms to type; but although more or less urobilin is to be expected, its absence does not

always contra-indicate blackwater fever; it merely indicates that this pigment substance—an end-product of the metabolism of hæmoglobin—has been absorbed into the blood-stream from the intestine, and passed to the liver via the portal circulation. In the liver the hepatic cells may manage to deal with the lot, so that none of it reaches the general circulation, to be excreted by the kidneys.

The content of albumin is variable, and the variations merely indicate the degree of response of the kidneys to the unnatural strain which is being imposed on them.

As regards casts, Ross—in an excellent description of the urine in this disease—says: [36]: ". . . Speaking generally, it may be said that although casts are frequently found in the earliest specimens of urine passed, the general tendency is for the amorphous deposit to be greater in amount than the casts in such specimens. . . . As the disease progresses casts usually become more numerous, and generally persist for some time after the urine has cleared and when amorphous deposit is no longer present."

(4) The Liver and the Kidneys.—The outstanding feature of blackwater fever is a quick, massive destruction of red blood-cells. How this dramatic hæmolysis occurs, and where, is fully discussed by Christophers and Bentley [31] and others [7]. In dealing with differential diagnosis we must bear it in mind, and consider its effects. Thus:—

(*a*) A sudden and intense strain is thrown on the reticulo-endothelial cells. Normally, these cells absorb the usual wear-and-tear products of red blood-cell destruction, by converting the liberated hæmoglobin into bile-pigment. This pigment is passed by the reticulo-endothelial (Kupffer) cells of the liver, through the polygonal secretory cells to the bile capillaries and eventually finds its way into the intestines. But under certain abnormal conditions, obstruction to the outflow of bile may occur; and this may lead to re-absorption of the pigment into the blood-stream or—if the polygonal cells be damaged—to absorption into the plasma from the Kupffer cells.

Now, the capacity of the reticulo-endothelial system to manufacture bile pigment from hæmoglobin usually exceeds the capacity of the polygonal cells to pass the pigment on to the bile capillaries. Hence, in a case of sudden and massive formation of hæmoglobin, one would expect: (i) Increased secretion of bile, with dark-coloured stools, and more or less severe and persistent vomiting; (ii) absorption direct from the Kupffer cells, with resultant jaundice.

This bilirubinæmia gives a positive Van den Bergh reaction, direct or indirect. In Rhodesia, Ross found that, in 30 cases, 25 gave the indirect reaction; and 5 only, the direct. However, it must be remembered that this reaction is apt to be obscured in the presence of hæmolysis [37].

(*b*) As a rule, the kidneys provide the first outward sign of hæmoglobinæmia. By analogy, it is reasonable to assume that the kidneys have

a "threshold value" for hæmoglobin; and that, when the concentration of hæmoglobin in the plasma has passed a certain point, the kidneys excrete this substance in an effort to restore the normal balance.

The response of the kidneys to an abnormal load will vary with the weight, state, etc., of the particular kidneys involved; and the consequent damage will range from minor and temporary injury, through degeneration of the epithelium, to major destruction ending in anuria.

As this sequence of events starts with sudden and massive liberation of hæmoglobin, it will at once be realized how important it is to discover what pulls the trigger. If it is the direct ætiological agent of blackwater fever, we are still in the dark; if it is plasmoquine poisoning, *per se*, we know where we are; but if there is a factor common to these two conditions, we have here, maybe, a fresh starting point for further investigation. The writer is of opinion that the case records of the ten patients included in this series tend to emphasize the probability that the third hypothesis, hazarded above, may prove to be the right one [38].

In Plasmoquine Poisoning.

The clinical and pathological characteristics are, practically speaking, indistinguishable from those of blackwater fever, except that:—

(1) Oxyhæmoglobinæmia, with oxyhæmoglobinuria, is never a result of this form of poisoning.

It does occur in blackwater fever.

(2) So-called cyanosis is a feature of the poisoning.

It is not met with in the fever.

It is therefore very desirable to determine spectroscopically which form of hæmoglobinæmia is present.

As regards cyanosis, it has been said that it is often difficult to detect this sign in Indians. That is true, when the sign is of a mild degree. But when it is moderate or severe, it is as easy to detect in an Indian as pallor is in an Englishman or jaundice in a Chinaman. Cyanosis was a prominent sign in the Quetta cases.

When it is noted that a patient is suffering from oxyhæmoglobinuria, and that cyanosis is not present, it is clear that—in the present state of our knowledge—a diagnosis of blackwater fever is preferable to one of plasmoquine poisoning.

On the other hand, when the guide-posts are methæmoglobinuria and cyanosis, plasmoquine toxicity suggests itself, to the exclusion of blackwater fever.

With these final, general remarks, the cases are now presented in detail to the reader who, it is hoped, will exercise his own judgment in arriving at a suitable diagnosis for each of the patients. It will, however, be noticed that in the case records there are many missing links; and it is not asserted that the observations of our various workers are, in every respect, scientifically adequate and accurate; in the circumstances of the case it

could hardly be otherwise. Nevertheless it is felt that here we have sufficient material to stimulate thought, and to encourage investigation in the unwanted event of a repetition of a similar series of cases.

THE TEN CASES DESCRIBED AND DISCUSSED. 1932.

Case 1.—An Indian infantry officer. A Mussalman of Haripur, Hazara District, N.W.F.P.

Aged 45. Service, 27 years, including East Africa, 1915-16.

Never served in, nor even visited, blackwater fever areas in India. He is said to have stated to a relative that, while in East Africa, he had an illness identical with the present one.

August 24.—Admitted to hospital, Fort Sandeman, complaining of symptoms suggestive of malaria, of one day's duration. No recent history of malaria elicited, but spleen is enlarged three fingers. Temperature normal. No parasites seen in blood-smears.

August 25.—Temperature 98·8° F. Malignant tertian rings found in blood-smear. Treatment: mist. alkaline, twice daily; quinine, grains x, twice daily; plasmoquine, 0·03 (0·01 and 0·02) gramme daily.

August 26.—Afternoon temperature rose to 102·2° F. Night temperature fell to subnormal, and remained down until afternoon of August 29. During this period progress was good, and there were no clinical signs or symptoms to note.

August 29.—Afternoon temperature rose to 101·6° F. Treatment: quinine-plasmoquine discontinued; simple diaphoretic mixture prescribed.

August 30.—Patient's condition remained satisfactory until, at 3 a.m., he vomited watery, bile-stained fluid. Slight diarrhœa occurred (no blood or mucus) and dark coloured urine was passed.

At 6 a.m. temperature was 101·6° F. Patient was very anæmic, and slight jaundice—including the conjunctivæ—was noticed. Bilious vomiting was frequent, and the urine was dark and tarry. Treatment: hot packs to the loins; mixture of sod. bicarb., calc. lactate and adrenalin; glucose by the mouth, and later per rectum.

By 10 a.m. the jaundice was markedly increased; and by noon the patient was semi-conscious. Anæmia and jaundice had become intense.

7.15 p.m.: Collapse and death.

The officer in command of the hospital—who had dealt with blackwater fever in Africa—made the following comments: "This was a most unusual case to be seen in Baluchistan, where blackwater fever is unknown. Although several thousands of cases of malaria have been dealt with both amongst the military and civil population at Fort Sandeman, not a single case of malaria with hæmoglobinuria has been recorded. The onset was sudden and the symptoms were of great severity. Intense anæmia, deepening jaundice, bilious vomiting and hæmoglobinuria were unmistakable signs. There was no history of recent malaria, but enlargement of

the spleen indicates that the patient must have suffered in the past from repeated slight attacks, insufficiently treated by quinine."

The African element in this case has already been discussed; and doubt has been expressed on the likelihood of a blackwater fever infection flaring up after a quiescent period of sixteen years.

Treatment was stopped with commendable promptitude, and after the patient had taken but ninety grains of quinine and 0·13 gramme plasmoquine, spread evenly over four and a half days. This had no effect whatever in checking the severity and rapidity of the attack [39].

Intense jaundice and profound anæmia were observed but cyanosis was not present [40] and [34].

It is unfortunate that, beyond the discovery of malignant tertian rings in the blood, laboratory examinations of the blood, urine, etc., were not carried out.

Case 2.—A Punjabi Sikh officer of the Indian Medical Department.

Aged 32. Service 8½ years. Has never lived in a blackwater fever area and, since joining the Army, has served continuously on the N.W. Frontier.

September 17.—Admitted to hospital, Peshawar, with a recent history of "fever of two days' duration." There is a past history of chronic malaria, including malignant tertian at Harnai, 1929, and at Ambala, 1930. During the 1930 attack the urine was dark, but not port-wine coloured. Both Harnai and Ambala are west of the Surat-Dehra Dun line.

The patient is an irregular quinine taker [8]. Temperature 100·4° F. falling. No parasites in blood-smear [41]. Treatment: Non-specific. Diaphoretic mixture.

September 20.—Temperature normal. General condition good. Blood-smears still negative. Diagnosed "clinical malaria."

Treatment: quinine, grains x, thrice daily: plasmoquine, 0·02 gramme twice daily.

September 22.—Temperature 99° F. Thick and thin films of blood still negative for parasites. Jaundice has appeared, and there is a "feeling of fullness" over the liver. Both liver and spleen are slightly enlarged and tender.

Plasmoquine stopped, the patient now having taken 0·08 gramme spread evenly over two days.

September 23.—Temperature 99·8° F. Patient looks ill and feels depressed. Nausea is present, and frequent, persistent and severe vomiting has set in. Jaundice is marked.

Urine: clear, port-wine colour; alkaline: specific gravity 1020. Albumin + + +; blood +; urobilin −; bile salts and pigments −. Amorphous phosphates + +; epithelial cells and granular casts +; blood-cells −; oxyhæmoglobin by the spectroscope +.

Red blood-cells, 2,200,000; polymorphonuclears, 42 per cent; lymphocytes 52 per cent; large mononuclears, 2 per cent; and eosinophiles, 4 per cent.

The case was diagnosed "blackwater fever," and treated accordingly. Quinine was stopped, ninety grains having been administered evenly over three days.

September 24.—No improvement in the general condition. Constant nausea, severe and persistent vomiting, hiccough. Urine still port-wine coloured.

7 p.m.: An intravenous injection of sod. bicarb. with glucose was at once followed by a rise of temperature, intense pallor, partial coma, delirium and collapse. For a time the patient's condition was very critical [42].

9 p.m.: Temperature 104·6° F. Condition improving.

11 p.m.: Temperature falling. Condition much improved.

At 7.30 p.m., and again at 2 a.m., on September 25, atebrin, 0·9 gramme, was administered.

It was reported that, on September 21, patient had taken a cold bath [43].

September 25.—Port-wine coloured urine passed at 9 a.m. Jaundice is still present, and bilious vomiting is persistent and distressingly severe.

4 p.m.: General condition very poor. Marked pallor. Port wine-coloured urine passed.

Blood examination.—Red cells, 1,400,000: white cells, 10,800: hæmoglobin, 20 per cent.

5·30 p.m: 400 cubic centimetres of blood transfused.

7 p.m.: Rigor. Temperature 101° F. [42].

8 p.m.: General condition is already improving, but the patient vomits everything, including atebrin.

September 26.—Patient looks and feels better, but vomiting persists.

Blood examination.—Red cells, 3,200,000: white cells, 12,000: hæmoglobin, 20 per cent.

8 p.m.: Patient is distinctly better. Vomiting has lessened in frequency and severity. Port-wine colour in the urine is less marked.

September 27.—6 a.m.: Vomiting now consists of clear mucus without trace of bile. Seven ounces of normal urine passed.

9.30 a.m.: Temperature 99·8° F. Patient is drowsy, and complains of great thirst. No vomiting has occurred since 6.30 a.m.

Treatment.—Additional to 0·1 gramme atebrin thrice daily—quinine bihydrochlor, grains iii, intramuscularly, morning and evening.

From now onwards, the patient made slow progress towards recovery. Occasional mild relapses occurred.

September 29.—Intramuscular injections of quinine stopped.

Red cells, 4,000,000; white cells, 5400. Polymorphonuclears, 60 per cent; lymphocytes, 34 per cent; large mononuclears, 2 per cent; eosinophiles 4 per cent.

October 5.—Improvement maintained. Evening temperature, 99° F. Vomiting has not yet entirely ceased.

Treatment.—Atebrin continued. A four days' course of plasmoquine. 0·03 gramme daily, begun.

October 10.—Temperature varies from normal to 99° F. Infrequent, but not severe, bouts of vomiting continue. Icteric tinge still persists. Liver slightly enlarged and tender. Spleen apparently normal.

October 13.—Atebrin stopped. "Esanofele" prescribed.

November 4.—Patient boarded for discharge to sick furlough.

These notes present a fairly complete picture.

Onset: Sudden and severe.

Rapid and massive destruction of the red blood-cells.

Profound pallor, intense jaundice—with intractable bilious vomiting—but no cyanosis.

Also, the clinician put this question to the pathologist: "Is the hæmoglobin methæmoglobin?" The answer was: "No."

Finally, only 0·08 gramme plasmoquine was taken, over two days; the drug was stopped in the initial stage of the attack, and well before the signs and symptoms had become classical; and nevertheless, the illness progressed to a point at which the patient's life was in jeopardy. As in Case 1—if plasmoquine alone was at the bottom of the trouble, why did not its cessation lead to an early and distinct amelioration of the attack [34].

Case 3.—A Pathan Infantry N.C.O.

Aged 23. Service 4½ years. Has never served, or resided, away from the N.W. Frontier.

This is the patient whose case is referred to in Note [25] and for whom the assumption has been made that plasmoquine was inadvertently administered.

November 15.—Admitted to hospital, Kohat, with signs and symptoms of malaria, of four days' duration. Patient stated that he had been free from malaria since his last admission to hospital a year ago.

Temperature last night 102·3° F., and this morning 99·3° F.

Blood smear contains benign tertian rings.

Treatment.—Quinine, grammes viii, thrice daily.

Evening temperature rose to 105·3° F., but no other untoward signs or symptoms developed.

November 16.—Temperature at 6 a.m. was 102·2° F., and at 9 a.m. 98·2° F., when quinine was discontinued, and atebrin, 0·1 gramme thrice daily, prescribed. This drug was continued up to November 19 inclusive. From certain entries on the patient's temperature chart (not confirmed by other documents) it has been assumed that from November 17 to 19, 0·02 gramme plasmoquine was administered daily. This, however, is stoutly denied by the medical personnel who had charge of the case.

November 17, 18, 19.—Temperature normal. General condition good.

November 20.—8 a.m.: One dose of atebrin given, making 1·0 gramme of this drug in all, spread evenly over a period of three days. Possibly the patient has also had a total of 0·06 gramme plasmoquine.

Patient feels unwell, and has developed a yellow discoloration of the skin. This discoloration the officer in charge of the case attributed to atebrin; but from what followed it is clear that it was, in fact, jaundice.

3 p.m.: Patient looked ill and fainted.

4 p.m.: Temperature 103·2° F. Yellow-coloured (bile-stained ?) fluid vomited on two occasions.

Treatment included quinine, grains viii, thrice daily.

November 21.—Patient looked, and felt, ill. Temperature ranged from 100° to 101° F. Yellow discoloration of the skin deepened, but the conjunctivæ did not seem to be affected. Colour of stool, brown.

No parasites found in the blood-smears.

November 22.—Temperature varied from 99° to 100° F. Pulse, 120.

Patient semi-comatose: general condition very bad.

Skin deeply jaundiced. Pillow-cases and bed-sheets stained yellow.

Liver and spleen not apparently enlarged.

Blood.—No parasites. Red cells, 2,100,000. Anisocytosis: poikilocytosis: polychromatophilia and a moderate degree of punctate basophilia. White cells, 16,000. Polymorphonuclears, 66 per cent; lymphocytes, 24 per cent; large mononuclears, 9 per cent; eosinophiles, 1 per cent. Van den Bergh's test, negative. No atebrin detected in the serum. This was the first occasion on which a test for atebrin was employed.

Urine.—A catheter specimen. Colour, deep brown. Reaction, neutral. No bile present. Heavy deposit of amorphous urates, a few red blood cells, a few renal epithelium cells and no casts. Spectroscopically, oxyhæmoglobin; presence of methæmoglobin doubtful. Test for atebrin, negative.

Fæces.—Chemical test for blood, negative.

November 23.—Temperature ranged from 99° to 103·5° F. General condition deteriorated.

6 p.m.: No urine has been passed since the evening of November 22. A few drops were withdrawn by catheter; colour, deep red; laboratory examination yielded substantially the same results as on November 22.

Blood.—As on November 22; but the red cells show a further slight diminution.

No atebrin in a specimen of cerebrospinal fluid.

November 24.—Temperature 98·5° to 100·4° F. General condition slightly improved; patient talked and answered questions.

Bladder again catheterized; only a few drops of urine, of a dirty brown colour, withdrawn.

Laboratory examinations repeated, with the same results as on November 22 and 23. The red blood-cells have again fallen slightly, and the picture is that of pernicious anæmia.

Quinine increased from xxiv to xxx grains, thrice daily. In addition, quinine bihydrochlor., grains ii, was administered intravenously at 11 a.m. and 5 p.m.

November 25.—No change. Spectroscopic bands of oxyhæmoglobin persist, with a suspicion of methæmoglobin.

November 26.—Temperature 103·8° F. since last night. General condition very grave. Complete anuria persists.

Laboratory examinations yield the same results as before.

4 p.m.: Collapse and death.

Here we have a case which, we know, was prejudged from the outset; and we are all aware of that weakness in human nature which tends to incline us to fit our findings to our predilections. In the confidence—a confidence which *may* be well founded—that no plasmoquine had been given, and in the mistaken belief that this was a case of atebrin poisoning, the medical officer put himself in a false position, and laid certain of his observations open to inquiry and criticism. Thus, were the conjunctivæ really free from any stain; and what was the actual colour of the conjunctivæ? [44]. Then again, an indirect positive Van den Bergh reaction was to be expected; but—as above mentioned [37]—even if the technique was faultless, this test may be upset in the presence of very rapid and intense hæmolysis. Enlargement, with some tenderness, of liver and spleen was also to be expected: and it is unfortunate that (as so often happens in Indian fatalities) permission for post-mortem examination was refused.

The outstanding features of the case may be summarized thus:—

A history of chronic malaria.

Ring forms of parasites, at a time when both benign and malignant tertian were rife in Kohat [17].

Sudden onset of acute and grave illness.

Marked jaundice. No cyanosis noted.

Rapid and marked destruction of red blood-cells. Persistent oxyhæmoglobinæmia; methæmoglobinæmia doubtful throughout.

Characteristic urine, with terminal anuria.

Again, we observe that but a small quantity (if any) of plasmoquine was taken; and that cessation of the drug did not influence the severity, progress or outcome of the attack.

REFERENCES.

[35] Ross. "Researches on Blackwater Fever in Southern Rhodesia," p. 106.

[36] *Idem. Ibid.*, pp. 164-196.

[37] Beaumont and Dodds' "Recent Advances in Medicine," 1929, p. 157.

[38] *Cf.* "[13]," p. 414: remarks by Dr. Manson-Bahr.

[39] See Sinton and Bird; and Sinton, Smith and Pottinger. "Studies in Malaria, with Special Reference to Treatment," *Indian Journal of Medical Research*, July 28, vol. xvi, No. 1, and January 30, vol. xvii, No. 3. Both papers contain the records of much valuable clinical and literary research.

[40] Manifold, in the Journal of the Royal Army Medical Corps, May-June, 1931.

[41] In blackwater fever, about 25 per cent. of the cases show no parasites. "The parasites are often absent; when present they are not numerically proportionate to the severity of the attack, and usually disappear as the disease progresses; sporulation does not correspond in time with the symptoms; hæmoglobinuria may be associated with different forms of the malarial parasite." See Deaderick, *ibid.*, p. 160.

[42] "Ross says—and with this I agree—that there is no evidence to support the view that intravenous injections of alkali or blood transfusions are advantageous during the actual hæmolytic process. I have seen the most violent reactions after such injections. It may well be that intravenous injections are dangerous, and until we know more about the hæmolytic process, and where it occurs, it is impossible to say." Dr. Manson-Bahr. See "[7]," p. 234.

[43] *Cf.* Ross. *Ibid.*, p. 86.

[44] In Indians, and especially in hookah smokers, it is not always easy to detect yellow or bilious staining of the conjunctivæ. The clear, china-white of the sclera of the negro is, in the Indian, often a light, dirty brown.

At one time it was thought that atebrin stained the skin, bnt not the conjunctivæ; but, since then, many cases of conjunctival staining by atebrin have been reported in military medical practice in India, and it is noted in the *Tropical Diseases Bulletin* for April, 1933, p. 199. "A yellow staining of the skin and conjunctiva appears occasionally in patients who are under treatment, but this is quite distinct from any toxic action, and is due to the staining properties of the drug."

On November 22 it was reported, as evidence of atebrin poisoning, that the patient's bed linen was stained yellow, but—"The secretions are coloured with bile-pigment. The sweat tinges the linen . . ." See "Jaundice," in Osler's "Principles and Practice of Medicine," eleventh edition, McRae, p. 555.

(*To be continued.*)

A FEW REMEDIAL EXERCISES.

By Major T. F. KENNEDY,
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I am very diffident at introducing the subject of remedial exercises, but I shall feel more than justified in the attempt if I succeed in setting the controversial ball rolling in what, for the Army, is a very important subject. I lay no claim to being an authority on the subject, and shall welcome any criticisms or suggestions which this article may promote.

I approached the matter originally at the Army School of Physical Training, Aldershot, from the point of view of instructing the Physical Training Staff in a few practical points in the treatment, by exercises, of the deformities more commonly met with in the Army, so the exercises suggested are based to a large extent on those already incorporated in the Physical Training Tables for Recruits of all Arms. Such exercises as were not in the tables have since been recommended for inclusion.

It is suggested that physical training should provide the general basis for remedial work in the Army, and as it would usually be carried out by physical training instructors working under the direction and supervision of medical officers, it is thought that these officers might find the suggestions in this article of use.

Remedial work is of great importance in preventing wastage in time of peace, but becomes infinitely more so in war when convalescent depôts would be full of men needing special exercises to render them fit.

Causes of Deformity.

I will not attempt to tabulate the various causes of deformity, but it is obvious that exercises could hold out little hope of improving any of a bony nature, consequently their utility would be confined to those of a ligamentous or muscular origin, or a combination of both.

Deformities Met With.

The more common deformities met with are :—

(1) Flat-foot.

(2) Exaggerated lumbar curve with lax abdominal muscles and consequent tilting forward of the pelvis.

(3) Lateral curvature of the spine.

(4) Unilateral development.

(5) Exaggerated forward curve in the dorsal region.

(6) Pigeon chest.

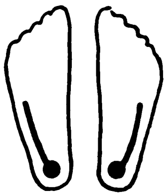
(7) Any injured and impaired muscle group.

(1) *Flat-Foot.*

Predisposing Causes : (a) Constitutional.—I do not propose to enlarge on this.

(*b*) *Occupational.*—Continual standing must have an effect by putting increased strain on the structures forming the arches.

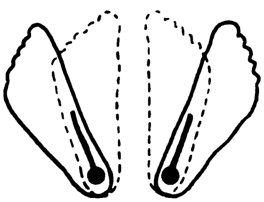
I should like under this heading to draw attention to the influence which high heels, or in fact any heels at all, have in throwing increased weight on the arch of the foot. When a person is standing erect the weight on the body is directed through the ankle-joint mainly on to the heel, with a slight proportion of the strain diverted on to the outer side of the longitudinal arch, and thus on to the base of the fifth metatarsal (see diagram).



NOTE that no weight is borne on the inner side of the arch—the ball of the great toe rests on the ground, but there is no pressure on it.

When the heels are raised, even to a slight extent, the weight is thrown forward and the main part of the strain is thrown on to the arch and transmitted through it to the ball of the great toe. So it is evident that, when standing with a raised heel, the arch of the foot which normally should be resting is subjected to strain.

The throwing of the weight from the back and outer on to the back and inner parts of the foot decreases the area of the pedestal on which the body is balanced; the toes are pointed out to compensate this, and this splaying of the feet aggravates the strain on the inner side of the arch when walking.



Dotted line shows position of normal feet.
Continuous line shows the compensatory splaying necessary to preserve balance.

Causes.—The more common are :—

(*a*) Stretching or contraction of the intertarsal and metatarsal ligaments.

(*b*) Weakness of, or stretching of, the following muscles :—

(i) Anterior tibial group, consisting of tibialis anticus, extensor longus digitorum and extensor proprius hallucis. (Action of this group is to flex the ankle-joint and raise the longitudinal arch of the foot.)

(ii) Tibialis posticus. (Action—helps to support the inner side of the longitudinal arch and prevents the astragalus from being crowded down between the calcaneum and the scaphoid.)

(iii) The small muscles of the sole of the foot which stretch between the two pillars of the main arch. (Action—approximation of the two bases of the arch with an upward bending of it.)

(iv) Peroneus longus. (Action—it prevents the transverse or minor arch from spreading by extending down behind the external malleolus, turning forward at its lower end at an angle of 60°, passing forward along the outer margin of the foot to the groove in the cuboid bone where it takes another turn of about 100° to extend diagonally forward and across the sole of the foot to its insertion at the base of the first metatarsal and outer side of the external cuneiform bone.)

(*c*) Traumatic. Where injury to the plantar or other ligaments occurs from trauma, e.g. landing with a jar on a hard surface.

Correction.—(1) Removal of cause.

(2) Exercises to increase the tone and strength of those muscles at fault. If we take the muscle groups whose defections are mainly responsible we shall be working on a logical basis.

ANTERIOR TIBIAL GROUP.

Starting Position	Exercise	Remarks
Quick March	1. Rapid Marching	To be carried out as fast as possible, with short steps and toes pointing slightly inward
	2. Walking on heels	
Hips firm, one knee raise	1. Foot flexing 2. Foot inward rolling	Could be added to any balance exercise. Gives exercise to all the muscles that have an action in the arches of the foot
At wall bars, standing position, hips firm, feet support	1. Trunk inclining backward	Trunk to be lowered backward as far as possible
At wall bars, sitting position, hips firm, feet support	1. Trunk inclining backward	Trunk to be lowered to the ground

NOTE.—(*a*) When landing from jumping exercises feet should be apart and toes should be turned slightly inward.

(*b*) When landing from a height or with forward impetus feet should be in same position as in (*a*) and forward movement should be continued.

TIBIALIS POSTICUS AND PERONEUS LONGUS.

Starting Position	Exercise	Remarks
Sitting position, feet astride	Feet turned inward	Chiefly develops the tibialis posticus without any weight being thrown on the arch as in later exercises
All exercises of "Heels raising" type from the tables		In marked cases of flat-foot these should not be given until the muscles have been strengthened by non-weight bearing exercises

SOLE-OF-FOOT MUSCLE GROUP.

Starting Position	Exercise	Remarks
Feet astride, hips firm	1. Alternate foot arching	Should be done with shoes and socks removed, which gives more freedom of movement
Feet closed, hips firm	2. Feet arching	
Feet astride, hips firm	1. Alternate sole of the foot turning inward and foot arching	
,, ,, ,, ,,	2. Alternate heel placing forward on the ground and foot arching	
,, ,, ,, ,,	3. Alternate toes placing forward on the ground and foot arching	This exercise also develops the tibialis posticus and peroneus longus

NOTE.—All these anti-flatfoot exercises are merely suggested as a guide, and can easily be added to, or modified, to suit circumstances.

(2) *Exaggerated Lumbar Curve with Consequent Forward Tilting of the Pelvis and Lax Abdominal Muscles.*

Predisposing Cause: Postural.—In this connection, again, high heels play their part. The raising of the heels throws the weight of the body forward, and a compensating backward bend takes place in the lumbar region of the spine to counteract the forward inclination of the lower extremities.

Causes: (*a*) *Ligamentous.*—Contracture of the posterior and stretching of the anterior intervertebral ligaments in the lumbar region.

(*b*) *Muscular.*—(1) Contracture of the dorsal muscles of the lumbar region. (2) Laxity of abdominal and hamstring groups of muscles.

The following diagrams illustrate how the forward tilting of the pelvis is associated with the condition, and how abdominal and hamstring groups of muscles both need to be considered in its correction.

FIG. 1.—Shows normal erect posture with body balanced evenly on the hips.

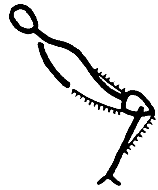


FIG. 2.—Shows the tilting of the pelvis when the body bends forward. Note the hamstring muscles are on the stretch.

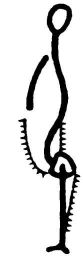


FIG. 3.—Shows erect posture but a forward tilting of the pelvis. Note the stretching of the hamstring and abdominal muscles.

Correction.—Should be directed towards stretching the muscles and ligaments which are contracted, and shortening those which are over-stretched.

(*a*) *Exercises for stretching the posterior ligaments and the erector spinæ group of muscles.* (1) All exercises from the tables of the "lying on back" to "forward reach" and "floor beat" variety (knees in this case should

not be kept straight.) (2) Trunk bending down quickly and up to "arms bend" position. (3) Sitting position, legs straight, feet or ankles grasp, trunk bending forward.

(*b*) *Exercises for shortening abdominal group of muscles.* All exercises in Group VI (abdominal exercises) of the Recruits Tables. (Attention must be paid in these exercises that the muscles are given work when fully contracted more than at normal or extended length.)

(*c*) *Exercises for shortening hamstrings.*

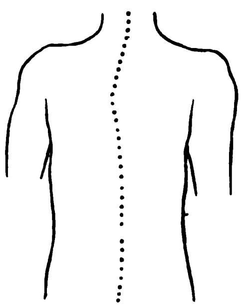
	Exercise	Remarks
1.	Correct position of attention	Practised by standing with back against wall and pressing lumbar region into wall. (Position should be held for a little while)
2.	Hips firm—leg backward raise and strongly stretch. Later — knee bend	Body must be kept as erect as possible and leg raised as high as possible
3.	Lying (on the face)—legs raising. Later—knees bending	The body must not be raised in doing this exercise
4.	At wall bars, hang on top bar, face to bars—knees bending	

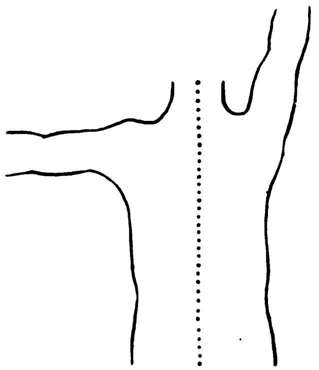
(3) *Lateral Curvature of Spine.*

Causes.—I will not touch on these.

Correction.—Search for a "key-note position" in which the lateral curvature is corrected, and then slowly get the subject to relax the other muscle groups which helped him to assume the position, but try hard to maintain correct position of the spine by use of the spinal muscle alone—constant practice of this should be carried out.

[NOTE.—Manipulation of both arms should be done until the "key-note position" is discovered.]





Key-note position which automatically corrects the deformity.

EXERCISES FOR CORRECTION OF CURVATURE.

1.	Feet astride, hips firm	Trunk bending sideways
2.	Feet closed, one arm bend, and one hand hips firm	Trunk bending with arm stretching
3.	"S" position, feet astride	Trunk bending sideways. (Later quickly)
4.	On knee, hands on head	Trunk bending sideways
5.	Hips firm, foot support	Trunk bending sideways. (Later—with arms upward stretch)
6.	Hips firm, hip support	Trunk bending sideways. (Later—with arms upward stretch)

(4) *Unilateral Development.*

Causes.—Occupational, recreational, etc.

Correction.—Obtained by exercising specially those muscles which are weak until they are equally developed to their fellows of the opposite side—then continue with harmonious bilateral development.

(5) *Exaggerated Forward Curve in Dorsal Region.*

Predisposing Causes.—Occupational position, etc., e.g. bending over a desk. Slovenliness in carriage, constitutional, etc.

Correction.—Exercises directed to reduce the curve and to strengthen the muscles for holding the body erect.

	Exercise	Remarks
1.	Feet astride, hips firm—trunk bending backwards	The bracing backward should be confined to the dorsal region and should not take place in the lumbar region
2.	Kneeling position, sitting on heels—back stretching	The hands should be clasped behind the back and should not be raised when stretching
3.	Feet astride, trunk forward bend—arms swinging backward, forward and upward	
4.	Forward lying (on bench)—trunk bending backward	
5.	Lying on face—trunk raising	
6.	(Double beams). Back support—hanging. Later—swinging	These exercises should be carried out very carefully under personal supervision of the medical officer
7.	(Wall bars,) Dorsal span bending with helper	

(6) *Pigeon Chest.*

Cause.—Constitutional.

Correction.—Those exercises which develop the pectoral group of muscles and tend to widen the chest wall.

1. Arms flinging from low cross to sideways stretch.
2. Arms flinging to flight.
3. Arms forward bend—arms flinging.
4. Arch hang / Full hang —arms bend. (NOTE.—The head should be allowed to go forward and elbows lowered in these two exercises so as to throw the maximum of the work on to the pectorals.)

(7) *Any Injured or Impaired Muscle Group.*

Correction.—In this case I should be guided by the muscle group or groups which need special attention.

Editorial.

REPORT ON THE HEALTH OF THE ARMY FOR THE YEAR 1932.

THE health of the Army during the year 1932 was remarkably good. The admission rate, 412·5 per 1,000 of strength, was the lowest on record; the invaliding and constantly sick rates, and the average sick time to each soldier, were the lowest recorded since the Great War.

The gradual improvement in the health of the Army is well illustrated in Chart No. I of the Report. There were slight rises for the admission ratios in 1927, 1929, and 1931 due to influenza. Excluding influenza the figures for 1932 are more favourable than would appear from the chart. In 1928, the previous year with the lowest record, 417·4 per 1,000, the influenza incidence was only 8·8 per 1,000, in 1932 the incidence was 22·9 per 1,000, so that there was really a fall of 27·8 per 1,000. Rather more than two-thirds of this is accounted for by a lower incidence of malaria and venereal diseases.

The principal causes of admission to hospital were: Inflammation of areola tissue; inflammation of tonsils; malaria; venereal diseases; and influenza; in the order mentioned.

Diseases of areolar tissue still give rise to the highest number of admissions to hospital; they are often associated with local injuries causing minor septic conditions, especially in the tropics. Boils alone caused 928 admissions. Provision for personal cleanliness, good diet and medical advice seem to have little effect in reducing these disabilities. High admissions for local injuries we must expect in a comparatively youthful population engaged in diverse manly exercises. Local injuries accounted for a larger number of admissions to hospital than any other medical or surgical condition and also gave rise to the highest death and invaliding rates and to the largest number constantly sick. There were 2,273 cases of fracture alone, causing twenty-seven deaths, mostly due to fractures of the skull and spine. But only fifteen cases were invalided, which speaks volumes for the efficiency of the treatment when we consider the high standard of functional activity that is necessary to enable a soldier to continue in the Service.

We have often referred in previous editorials on the health of the Army to the large number of admissions for tonsillitis and expressed the hope that bacteriological and other researches would find some method of diminishing, if not preventing, this loss of efficiency which appears in the medical statistics with deadly monotony year after year. At present there seems

to be little hope of finding a specific vaccine and preventive measures still have to be based largely on measures for minimizing the evil effects of communal life. These measures are mainly : Good wall space between beds ; central heating of rooms to prevent crowding round stoves ; sterilization of eating utensils ; and improved methods for cleansing barrack floors.

Malaria, the third great cause of admissions to hospital, presents a very different picture. Since 1921 there has been a gradual fall in the incidence of malaria ; in 1921 there were 99·8 admissions per 1,000 of strength ; in 1932 the admissions had fallen to 28·4. The total admissions for malaria in 1932 numbered 5,165, a ratio of 28·4 compared with 39·6 in 1931, and 41·5 for the period 1927-31. The decrease in malaria affected all countries where the disease is common. In China the admission rate fell from 76·4 in 1931 to 24·4, and that in Egypt and Palestine from 17·3 to 12·2.

In India there were 4,654 admissions for malaria in 1932, of which over 3,000 were for benign tertian, 1,586 being fresh cases and 1,615 relapses. In the Northern Command malaria has always been very prevalent. In 1925 the admissions were 291 per 1,000, but as a result of anti-malaria work the rate has now fallen to 91·15 per 1,000.

Prior to 1932 the lowest record of admissions was in 1928 ; but there were considerable differences between the two years. Climatic conditions were in favour of 1928, which was an unusually dry year, while in 1932 the rainfall was excessive in some places and in others there were heavy showers interspersed with dry spells—conditions favourable to mosquito development. In 1932 major engineering works were stopped owing to want of funds. The year 1928 was peaceful, but in 1932 the troops were subjected to hard work in conditions which made malaria prevention very difficult.

All these factors militated against a good year in 1932. There were, however, certain favourable factors—improvements in the quality of the field work and the use of plasmoquine on a large scale. The full results of the systematized administration of plasmoquine have not been received, but the facts now known seem to point to the intelligent use of this drug as the main cause of the record results in 1932. In the D.M.S.'s report from India the prophylactic value of plasmoquine is considered and reference is made to the large scale trials carried out in Burma in 1931 and 1932. The picture given in the report of the trial is regarded as too favourable. It was not possible to follow up the units and the dose, 0·02 gramme, given was considered as definitely too small. The correct dose was regarded as 0·03 to 0·04 gramme. The D.M.S.'s report states that this dose must be regarded as in the region of therapeusis rather than prophylaxis. The clinicians in India are now agreed that for therapeutic purposes a dose of 0·02 gramme daily in combination with quinine or atebrin is insufficient, but a dose of 0·03 gramme in combination with quinine or atebrin is effectual. Even in this dose the drug may be mildly toxic and it is not regarded as a

safe dose for soldiers carrying on their full duties in peace, let alone in war. A dose of 0·02 gramme of plasmoquine has an undoubted delaying action without interfering with the subjects physical activities. This may be of great importance in war.

As a therapeutic agent plasmoquine is regarded as having now an established value. Manifold gave the relapse rate under quinine treatment as 420 per 1,000. In 1932 the clinicians using plasmoquine and quinine secured a relapse rate per 1,000 which varied from 30·5 to 40·5. Dixon's figures ranged from 20 to 47 per 1,000. The value to India of these figures is manifest and a more hopeful view is now taken of the possibility of controlling malaria amongst British troops.

Atebrin was introduced into Army practice in India too late in the malaria season of 1932 to permit of definite conclusions being reached regarding its comparative value. The D.M.S. states that "the appearance of plasmoquine and atebrin has re-awakened interest in the whole subject of malaria in India and credit is due to all the clinicians and epidemiologists who have been working on the problem throughout the year. They have risen to the occasion."

Dysentery is an important cause of admission to hospital, especially in India where the admissions were 1,385 or 25 per 1,000, compared with 28·5 per 1,000 in 1931. It is interesting to note that this fall occurred in spite of the numbers of mild dysenteric infections which in the past were recorded as diarrhœa. In addition the admissions for diarrhœa are considerably fewer.

The admissions for dysentery in India would have shown a more noticeable decrease had it not been for the exceptional high incidence in Quetta. Of the admissions 15·52 per cent were protozoal and 62·53 per cent probably bacillary; 21·9 per cent were recorded as clinical. The types and numbers of dysentery bacilli isolated were: (*a*) non-mannite-fermenting group; *B. dysenteriæ* Shiga, 384; *B. dysenteriæ* Schmitz, 126: (*b*) mannite-fermenting group, 1440.

A new system of classification for the mannite-fermenting group has been brought into use. Hitherto the types of this group recognized were Andrewes' Flexner V, W, X, Y, Z and *B. dysenteriæ* Sonne, the remainder being grouped as "Flexner inagglutinable." Many distinct types have now been defined in the last group and by utilizing the late acidification of dulcite and saccharose it is possible to split this group into three sub-groups. Clinical data are being accumulated with a view to confirming the pathogenicity of the newly defined types.

The examination of menials handling food has been continued for five years. There is no record of a true carrier of bacillary dysentery. Supposed carriers have been found to be persons who when called up for examination were found at the time to be suffering from an attack of dysentery or, in chronic cases, from a relapse. The sequel of the present system has been the concealment of disease, a man continuing to work

when he was definitely infective. It is proposed to change the system and to encourage the active case of the disease to report sick. Intractable, relapsing cases will be discharged. Studies of amœbic dysentery have shown that the disease pursues a steady course and in no way reflects the variations in the supposed reservoir of infection constituted by cyst carriers. The routine investigation for the exclusion of cyst carriers will therefore be abandoned.

Venereal diseases, which rank fourth amongst the principal diseases causing admissions to hospital, gave rise to 4,957 admissions, or 27·2 per 1,000 of strength, as compared with 5,865 admissions, or 32·2 per 1,000, in 1931. A chart, No. VI in the Report, illustrates the highly satisfactory reduction in the incidence of venereal diseases during recent years. Even China, where local conditions make control very difficult, shares in the reduction, the ratio of admissions having fallen from 240·4 per 1,000 in 1931 to 128·9 in 1932.

In the Special Departments there are very interesting researches to note.

In the Department of Medicine an extended research on the cause of epilepsy in the Army has been carried out, and the results up to the present justify the belief that cysticercosis is a common cause of late-developing epilepsy. There are now records of forty-five proved military cases of cysticercosis, but it is certain that this number is far from complete for the period covered. India has produced the great majority of cases of infestation. It is suggested that an inquiry should be made into the prevalence of *Tænia solium* infestations in non-Europeans living in and around the cantonments in India, for so far as can be ascertained the majority of the sufferers from cysticercosis have never themselves harboured an adult *T. solium*. Most of the cases of intestinal tæniasis in British troops in India appear to be due to *T. saginata*, a species which does not cause cysticercosis in man.

In the course of the investigation some interesting observations have been made on the development of the embryos in man; while the radiological appearances of the early and progressive calcification of the cysts have been the subject of close study which has resulted in substantial additions to existing knowledge.

In the Department of Hygiene much work has been done on the chloramine treatment of water supplies. Major Stanley Elliott's researches at the Royal Army Medical College have shown that the proportion of chlorine to ammonia is most important. A proportion of 4 of chlorine to 1 of ammonia seems to give the best results. If the quantity of chlorine should fall and there be only 1 of chlorine to 1 of ammonia, sterilization of a raw water is not obtained for some hours owing to the formation of a slow acting form of chloramine—possibly monochloramine (NH_2Cl).

Some of the waters that had to be used in the Great War caused a very considerable absorption of chlorine; in a few seconds the blue colour of the indicator had disappeared. In these circumstances it seems to us that monochloramine might be formed and the water might not be sterilized in one hour. Fortunately, it appears that monochloramine (NH_2Cl) does not react with cadmium iodide, so that if the treated water shows a blue colour with the indicator, chlorine or some active form of chlorine must be present and water will be made safe in one hour.

It would seem essential to use the cadmium iodide and starch test when a standard dose of chloramine is employed for all waters.

The presence of ammonia in the water might also cause an undesirably low proportion of chlorine to ammonia; Major Elliott found a sample of *raw* Thames water containing 0·9 part per million of ammonia was not sterilized by two parts per million of chloramine for some hours. If, however, the Thames water was filtered a safe water was obtained in one hour. Major Elliott therefore recommended in his paper that water should be filtered before being treated with ammonia and chlorine.

Trials with the bulk-formed chloramine in the water carts (now known as the Harold-McKibbin method) have been carried out in Egypt and India; the reports, so far received, confirm the satisfactory results of laboratory and field tests at home.

Field trials have been made with the Elliott Mobile Water Sterilizer in the Aldershot and Southern Commands. In the Southern Command test the sterilizer travelled from the Royal Army Medical College to Salisbury Plain, a distance of ninety miles in four and a half hours, and within half an hour of its arrival was delivering 1,500 to 1,800 gallons of safe water. The water to be treated was obtained from the River Test, and the vertical lift from the river was ten feet.

Impressed with the results of the trials the Army Hygiene Advisory Committee have recommended that the plant should form part of the Field Hygiene Sections. Four plants will be required for each division dependent on water points for its water supply.

In the Department of Pathology Colonel Perry and his co-workers have continued their important research work on the production of a vaccine that will give greater protection against typhoid fever and paratyphoid fever. We published a third paper by these authors in the March number of the Journal.

In this paper they describe the investigations that have been made to compare the protective value of different typhoid vaccines by the correlation of mouse protection tests with the development of immune bodies in the human subject and in mice. They also give details of the present method of manufacturing typhoid-paratyphoid vaccine. In this vaccine the typhoid element is now a regenerated Rawlings strain of smooth type and the paratyphoid elements are *Bact. paratyphosum* A, strain Mears, and

Bact. paratyphosum B, strain Rowlands. The vaccine contains 1,000 million *Bact. typhosum*, 750 million *Bact. paratyphosum* A, and 750 million *Bact. paratyphosum* B, in 0·5 per cent carbol saline. By means of mouse protection tests carried out every three months an endeavour is being made to find out the period over which the vaccine retains its potency. Stored both at ordinary temperature and in a cold room the vaccine has been found to retain its protective properties up to the present time—twelve months after the preparation of the emulsions. It seems possible that the present expiry date of one year, which has been empirically fixed, may be extended, and considerable economy result when large reserves of vaccine have to be maintained.

Reactions following injection of the vaccine have been found to be negligible if the instructions as to rest are observed. Inoculation should not be carried out during the warm seasons in the tropics, or on board ship. Experience has shown that if the vaccine is suitably diluted quite young children may be inoculated without anxiety as the reactions are in no way unduly severe.

Clinical and other Notes.

CONCENTRATION OF COMPLEMENT AND AGGLUTINATING SERUM.

By Major R. A. HEPPLE, M.C.,
Royal Army Medical Corps.

AND

Assistant Surgeon W. BORNSHIN,
Indian Medical Department.

Through the courtesy of Dr. A. S. Plant and the Editor of the *British Medical Journal* we are permitted to publish the following note which appeared in the *British Medical Journal* of March 11, 1933:—

"Complement of High Titre.

"If one freezes solid a test tube of guinea-pig serum in a mixture of ice and freezing salt and then thaws it in either a water bath or incubator, and looks at it from time to time, a change will be seen taking place. On gently rocking the tube there is a movement of oily-looking streaks between the top and bottom portions, and ultimately, when the thaw is completed, a darker-coloured lower and a lighter-coloured upper portion will be observed. If, without shaking or inverting the tube, the freezing and thawing is repeated a few times the differences between the two portions are more marked, until the lower portion becomes highly-coloured and heavy-looking, and the top portion colourless. If the complement titres of the extreme upper portion and extreme lower portion are tested with sensitized sheep cells a vast difference in the two will be noted. The top may give a titre of 1 in 5 and the bottom 1 in 150. Evidently that portion of serum responsible for hæmolysing sensitized cells has largely migrated to the bottom of the tube. On inversion of the tube a few times the two portions blend together, and an apparent return to normal serum occurs.

"I found this out about a year ago, when, for economic reasons, I began to freeze solid and preserve in a freezing mixture in a vacuum flask in the ice chest the guinea-pig serum left over from the day's Wassermann tests.

"By applying similar methods, the greater part of the serum can be recovered from the saline dilutions employed in the Wassermann tests, and can be used again on another day. There did not appear to be much of practical value gained except the possibility of being able to preserve the high titre portion of the complement in liquid or powder form. In the frozen solid state I have kept it for six months, and obtained quite a good titre.

"I communicated my observations to Dr. B. J. Wyler, the Ministry of Health pathologist for serum tests for syphilis, who confirmed my findings with undiluted serum. Experimenting with the inactivated serum of rabbits immunized with sheep's red cells, he found he could get an increased hæmolytic titre of the lower portion. I am publishing this note after reading Dr. Gordon's account of the part played by complement fractions in combating disease, as it occurs to me that the freezing and thawing of serum which causes the separation of certain components may be of value to those who are working on this subject."

ARTHUR S. PLANT, M.R.C.S.
Venereal Diseases Medical Officer,
County Borough of Grimsby.

The Meerut District Laboratory is one of five laboratories in India which carry out the Wassermann tests. It undertakes the Wassermann tests for the Eastern Command. The laboratory remains in Meerut during the cold weather, and before the commencement of the hot weather it moves to Ranikhet in the Kumaon hills for a period of six to seven months. The laboratory animals move with it.

Our experience with regard to complement is as follows :—

In Meerut complement of good working titre can usually be obtained although some falling off is noticed in February and March. As a rule the move to the hills takes place in March. On arrival the complement approximates to the titre of that in Meerut, but a gradual falling off takes place which appears to reach its maximum after three or four weeks' residence in the hills. At this period it becomes difficult to obtain a workable complement and rebleeding in the hope of obtaining such a serum is of frequent occurrence. We have attempted to prevent this deterioration in complement in various ways, but so far without success. Stoves were installed in the animal house to minimize the effect of the sudden change of temperature. Lucerne cannot be obtained in Ranikhet, but a liberal supply of carrots, lettuce and vegetable tops has always been available. We feel certain that the question of feeding does not account for the low titre of the complement. A portable run was made so that the animals should have fresh air and sunshine in plenty.

At the time of the arrival of the *British Medical Journal* containing Dr. Plant's note we had been one month in Ranikhet and were experiencing our usual trouble and anxiety with regard to complement. The method described appeared to offer a way out of the difficulty, and we hastened to confirm it. A complement was titred and found to be 1 in 40 (complement row only). About five cubic centimetres of this serum were then placed in a centrifuge tube and lowered into a vacuum flask which contained a mixture of ice and common salt. About five minutes was sufficient to freeze the complement completely. It was then thawed in a water bath at 37° C. This method of thawing did not prove satisfactory owing to the

sudden loosening of the frozen serum from the sides of the tube and resulting mixing of the complement. Subsequent thawings were allowed to take place at room temperature. Freezing and thawing were repeated five times. The two layers described by Dr. Plant were well marked. On gently agitating the tube, an effect similar to the mixing of glycerine and water could be noted. A titration of the extreme lower portion was carried out with sensitized sheep's cells. Within five minutes complete hæmolysis in a dilution of 1 in 100 (complement row only) had taken place. This was the highest dilution put up, but we feel certain that the limit was not less than 1 in 150. A titration of the extreme upper portion was then carried out, and no appreciable hæmolysis was present even in 1 in 10 after half an hour in the water bath. About 1½ cubic centimetres of the bottom layer were then pipetted off and added to 4½ cubic centimetres of a complement having the useless titre of just less than 1 in 30 (complement row only). The two sera were thoroughly mixed and the resulting titre of the mixture ascertained. It proved to be over 1 in 50 (complement row only).

Further experiments have proved that by taking, say, 10 cubic centimetres of a complement, which when titred with the serum and antigen control rows will not give a workable complement, i.e. at least 1 in 30, it is possible by the freezing and thawing method to produce 4 or 5 cubic centimetres of complement with an average titre of 1 in 50 to 1 in 60. On trying out such a complement in the actual Wassermann tests with numerous controls it was found to work admirably and no anomalous results were experienced.

One has the belief that centrifuging at a very high speed would result in a similar concentration of complement. Perhaps someone with a high speed electrical centrifuge will try this out.

A minor but important point noted is that thorough mixing of the concentrated complement with the saline in the dilution tubes is necessary. The concentrated complement is rather viscid and tends to settle to the bottom of the saline if mixing is not thorough, but this presents no difficulty. A point which also emerges is that if one is ever using complement which has been frozen, thorough mixing is necessary to ensure an even titre throughout.

Concentration of Agglutinins.

As an extension of the principle described it was decided to carry out experiments to determine if agglutinins could be concentrated in a similar manner.

As all soldiers in India are inoculated with T.A.B. at definite intervals, their sera contain "H" agglutinins against T.A. and B. Patients' sera left over from the Wassermann tests were thoroughly mixed together, and the titre of the mixture against a standard emulsion of *B. typhosus* was ascertained. It was found to be a trace in 1 in 500. Freezing and thawing of the mixture was carried out four times. Separation into two layers was

well marked. The titre of the extreme upper and lower portions against the standard T emulsion was then ascertained. That of the former was 1 in 50, while that of the latter was a trace in 1 in 1000. A further experiment with a similar mixture of sera gave similar results.

Conclusions.

(1) That it is possible by alternate freezing and thawing to concentrate complement in the lower layer of the serum.

(2) That agglutinins may be concentrated in a similar fashion.

Practical Applications.

(1) During periods in which a workable complement cannot be obtained by direct bleeding, complement suitable for the Wassermann reaction may be obtained by the method described above.

(2) The practical application of the concentration of agglutinins is not so obvious. It is known, however, that it is difficult to obtain a high titre serum against some organisms. By the concentration method described it should be possible to obtain a small quantity of serum of high titre from a larger quantity with a low titre.

Our thanks are due to Dr. Plant and the Editor of the *British Medical Journal* for permission to publish Dr. Plant's note. They are also due to Jemadar Sarju Prasad, I.M.D., of this laboratory, who carried out the tests on agglutinins at our request and to the late Colonel J. A. Turnbull, D.S.O., A.D.M.S., Meerut District, for permission to forward this article for publication.

AN INTERESTING CASE OF CYSTICERCOSIS.

By Major E. B. MARSH, M.C.,
Royal Army Medical Corps.

The following description of the clinical history and post-mortem findings of the late Pte. J., who died at the Royal Victoria Hospital, Netley, on January 24, 1932, aged 28, as a result of cysticercosis of the brain, is published with the object of drawing attention to the varied symptoms and signs cysticercosis infection may produce. During the last eighteen months I have seen ten cases of cysticercosis all invalided home definitely diagnosed epilepsy major or *petit mal*, and all with varying types of symptoms referable to some pathological condition of the brain.

Pte. J. enlisted on February 2, 1924, and remained in England until November 12, 1926, when he went to Gibraltar; on February 7, 1927, he went to India; on November 9, 1930, he was transferred to Burma where he remained until May 28, 1931, when he was moved to the Andaman Islands, returning to Burma on August 14, 1931. During the first six years of his

service he was a perfectly fit man and well reported on by his Company Commander. He never suffered from any form of tapeworm.

On October 18, 1930, for the first time during his service, he was admitted to hospital at Bareilly suffering from severe headache, and ran a continuous mild pyrexia for five days, the cause of which was not discovered after all routine pathological investigations had been carried out. The symptoms were suggestive of a toxæmia, possibly of intestinal origin.

He left the hospital after seventeen days apparently perfectly fit, but this was only temporary, for a few weeks later the headaches returned while he was at Rangoon, and he was sent up to the British Military Hospital, Mingaladon, on March 26, 1931, with a history of five days' saddleback temperature and complaining of severe pains in the back and the head.

Dengue fever was prevalent at the time, and it was concluded, possibly correctly so, that he had an attack of dengue fever. Blood examination was negative for malaria parasites.

Two months later (June 11, 1931) he was again admitted to hospital, this time at Port Blair, suffering from similar symptoms—intense headache accompanied by pyrexia. The symptoms and signs again suggested some form of toxæmia. Blood-slides were negative for malaria and the Wassermann reaction was negative. After about three weeks in hospital he developed symptoms of insanity. He had delusions of persecution, with hallucinations of various types, and gradually passed into a state of stupor. These symptoms suggested some atypical form of delusional insanity, and on August 16, 1931, he was transferred to the British Military Hospital, Mingaladon.

By this time he was becoming extremely weak; his memory was good for past events, but poor for recent events. He alternated between fits of depression and well-being. There was double optic neuritis, the deep reflexes were absent, the plantar reflexes exaggerated. Hearing, smell and taste were unimpaired. There was a lack of control of the rectum and bladder. He had two further attacks of pyrexia and twice became partially collapsed. Blood-counts showed nothing abnormal; the urine was normal; an X-ray examination of the skull showed no abnormality. A lumbar puncture was carried out; there was no increase of pressure. The cytological report stated: Polymorphs, thirteen per cent; lymphocytes, eighty-seven per cent; globulin present; sugar nil.

The symptoms were beginning to suggest a disseminated sclerosis of an atypical character.

By September 25, 1931, he was in a very serious condition; he was bedridden, with incontinence of urine and fæces, and was practically blind. He still had headache, but no vomiting. The symptoms and signs were again changing, the diagnosis of disseminated sclerosis was not clearly established, and there was a strong suspicion of intracranial pressure, but there were no localizing signs.

He came home as a cot case on H. T. "Nevasa," reaching the Royal Victoria Hospital on November 18, 1931, in a semicomatose condition, with a weak pulse of between 46-56; he was quite blind, with a double optic papillœdema. The knee-jerks were increased, ankle-jerks increased; plantar reflex and extensor and abdominal reflexes were absent. Attacks of severe vomiting developed, giving the complete picture of a case of cerebral tumour without any localizing signs. He gradually sank and died on January 24, 1932. A post-mortem examination by Major F. G. A. Smyth was carried out and the following is his report.

Skull.—Dura mater was adherent to the pia-arachnoid by means of soft fibrous adhesions—these corresponded in position to yellowish cystic bodies embedded in the brain tissue surrounded by fibrous capsules. On section it was found that these cysts were cysticerci of tænia. The cysticerci were very numerous throughout both hemispheres of the brain and a few were found in the mid-brain. The medulla and cerebellum appeared free of these, but cysts were found embedded in the dura mater.

Skin.—A fibrous nodule was removed from the skin of the neck with a view to section to see if it was a fibroid cysticercus. The section proved negative. No subcutaneous cysticerci were found.

No cysticerci were found in any other organ of the body. Microscopic examination of the embryo worms showed the hooklets and suckers diagnostic of *Tænia solium*.

In conclusion, attention is drawn to the following points:—

(1) The duration of the illness. From the appearance of the first symptoms to the fatal termination was fifteen months.

(2) There was no history of a tapeworm infection and no tapeworm was found at the post-mortem examination.

(3) There were no cysts of cysticerci discovered in the skin, muscles or any other organ except the brain.

(4) The periodic attacks of pyrexia during the earlier stages of the illness are of interest from a diagnostic point of view.

I am indebted to very many medical officers for their various notes on the case, to Colonel W. P. MacArthur for kindly reviewing these notes, and to Lieutenant-Colonel H. L. Howell, R.A.M.C., Officer Commanding, Royal Victoria Hospital, Netley, for permission to forward the case for publication.

NOTES ON A CASE OF CYSTICERCOSIS.

By Major F. HOLMES,
Royal Army Medical Corps.

Lance-Corporal J. S. was admitted to hospital on December 11, 1930, and gave the following history: He stated that while in India, three or four years ago, he noticed he was passing segments of a tapeworm and had continued to do so on and off since. He complained that at intervals for three years he had had pain in his left chest, and that when this was

present he flexed his head rapidly to the right and was unable to control the movements. This had occurred on eight occasions and lasted about one minute each time. After arriving home in 1928 he noticed several small nodules appearing in his subcutaneous tissue, a few at a time. Since April, 1930, there had been periods lasting up to twenty-four hours when he was disorientated for time and place. He would lose his memory for things he had just done, and his mind would be a blank for periods up to twenty-four hours. His environment seemed strange, and suddenly he would recognize his surroundings and people that he had been unable to recognize before. He was a dispatch rider and at times would cease to recognize towns or the country he passed through, or the people he saw, but would arrive at his destination all the same. This was more apt to occur in cold weather. He often suffered from dizziness and on occasions lost his speech, this being associated with "little lights" in his eyes whether opened or closed, and objects appeared further away than they really were even if he was not looking specifically at them. Apart from this he occasionally had spots in front of his right eye, but his eyesight was good. He "felt as if he had no life in him."

He was admitted to hospital because he had two epileptiform fits on the day of admission. During these fits he had bitten his tongue and contused his lumbosacral region. I witnessed a third fit. He suddenly uttered a cry, became stertorous and cyanosed, had a fixed stare, put his tongue out to the right, flexed and extended both arms and the right leg, but the left leg remained stationary. At the same time he sat up in bed. All movements ceased after one minute and he became tonic. He was dazed after the fit and next day did not remember he had spoken to me the night previously. After the fit his right foot felt as if it wanted to extend and flex itself. During the fit both plantar reflexes were extensor in response and the deep reflexes exaggerated, although normally the plantar reflexes were flexor. He had nausea, but no actual vomiting with the fits. He stated that during the fits he felt as if he was being choked, and pain went down his right leg. He frequently had frontal headaches and usually for two days before the onset of each fit.

Clinical examination showed the following: There were many subcutaneous nodules; his tongue had been bitten.

Central Nervous System.—Sensations normal; general exaggeration of all reflexes; plantar reflexes flexor in response; cranial nerves normal; pupils unequal and reacted to light directly and consensually, and to accommodation; no nystagmus; no paresis; fundi normal; rales all over the chest; the heart and abdomen showed no abnormal signs.

Biopsy of the nodules showed the case to be an infestation with *Cysticercus cellulosæ.* A vermifuge of felix mas and "white mixture" caused him to pass a *Tænia solium.* The urine was normal.

The Wassermann test was negative. Cerebrospinal fluid: Wassermann negative; Lange test, 0111000000; one small lymphocyte per cubic

millimetre ; no increase of globulin ; slightly decreased reduction of Fehling's solution. X-ray examination of the skull gave negative results.

Previous illnesses: syphilis, 1927 ; pleurisy, 1921 ; bronchitis occasionally.

The case is interesting owing to the initial symptoms, particularly the disorientation for time and place before the onset of any epileptic fits. At that stage the case would have been a problem in diagnosis. The other point is that this patient actually had intestinal as well as somatic tæniasis. The previous cases I have seen have neither had, nor was there any history of, an intestinal infection.

The records of the above case have been written at the request of Colonel W. P. Mac Arthur, Consulting Physician to the British Army.

Echoes of the Past.

BRITISH SURGEONS IN THE PORTUGUESE ARMY DURING THE PENINSULAR WAR.

By Colonel MANOEL R. F. GIAO,
Director of Medical Services, Portuguese Army.

Translated from the French
By Lieutenant-Colonel A. D. STIRLING, D.S.O.,
Royal Army Medical Corps.

On March 7, 1809, William Carr Beresford was appointed Commandant of the Portuguese Army with the rank of Marshal. I believe that military critics are unanimous in their judgment that Beresford was a bad General in the field, but a remarkable organizer.

Beresford organized the Portuguese Army on lines that would not to-day be considered very sound. He did not wish to overthrow the whole structure, hoping that from the framework he might build up something new and efficient. He took in hand what he found and slowly, patiently, and with a firm hand, not without at times a touch of humour, he was able to make full use of the remarkable military qualities of the Portuguese.

On March 15 he published the first "Order of the Day" for the Army; in this document one can study his methods and work, but to appreciate these fully it is necessary to study his correspondence, especially with the Portugese Regency, which has not yet been completely investigated.

On March 29, some days after Beresford was appointed Commander-in-Chief, General Soult occupied Oporto after penetrating the northern frontier of Portugal. Beresford wished to advance to this sector, but General Craddock, commanding the British troops left in Portugal after the

departure of Sir John Moore, was of a different opinion and remained in the vicinity of Lisbon. One had to await the arrival of the future Lord Wellington, on April 26, to see the new Commander-in-Chief of the Allied Armies agreeing with Beresford's plan. I do not intend to discuss the operations, and this short reference is made with the sole object of showing the impossibility of Beresford being able to begin the organization at once—the military situation forcing him to keep his troops on the move, and the marches in the province of Tras-os-Montes were very strenuous.

Like all organizers whose work is remembered, Beresford was specially interested in the Medical Service and in the well-being of his men. A study of the reforms made by Beresford in the Army Medical Service is a very interesting subject, but it is not the object of this article. I merely wish to record the names of the British surgeons who, on Beresford's proposal, undertook duty with the Portuguese troops. The lessons of the brilliant British surgery were not unknown in Portugal at this time; thanks to Manuel Constancio, our famous anatomist and surgeon, several young Portuguese surgeons were sent to England to study surgery. This procedure was carried out for some time, and Beresford had surgeons who had been trained in England by service in military and civil hospitals. But the situation in the Army was not good; all the regimental surgeons had not received a uniform training. In military hospitals there were pupils of the anatomy schools, of the surgical department of the Hospital of St. Joseph at Lisbon, and also old practitioners and pupils of other old practitioners. We had in Portugal military surgeons who were really children of the Army, having entered at age of 13 and 14 years as surgical assistants; sometimes the surgical assistant was the son of the Surgeon-Major of the regiment.

In March, 1810, Beresford obtained authority from the Regency for surgeons to be graded as captains and the assistants as lieutenants—in both cases after examination. Before this surgeons were graded as lieutenants and the assistants as N.C.O.s without any commission from the King.

As brigade surgeons Beresford chose Portuguese surgeons, but he also engaged a certain number of surgeons from the British Army. Of many of these I have found no reference except in the books of the Treasury of the Armies.

In the Order of the Day of October 13, 1814, one finds the names of many British surgeons who returned to service in the British Army. After this date there remained in the Portuguese Army only five British surgeons: David Barry, John Clark, Frederick Jebb, Augustus West and William Wynn. In an article published in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS (first volume of 1930) some references to British surgeons in the service of Portugal appear; it is said that Fergusson was Surgeon-in-Chief of the Army until the end of 1812, when he was replaced by Burrows. As will be seen, Fergusson was Inspector-General of Hospitals and Burrows Surgeon-in-Chief. Brigade surgeons were promoted army

surgeons in the organization of 1813, and those who remained in the Portuguese Army received the rank of first army surgeon in the organization of 1816.

The following officers served with the Portuguese Army during the Peninsular War :—

John Barr.—He took service as Brigade Surgeon in March, 1812; was promoted Army Surgeon, January 29, 1814; returned to service in the British Army in October, 1814.

Sir David Barry.—Promoted Brigade Surgeon in February, 1813, for the Brigade composed of the 3rd and 15th Infantry Regiments; promoted Army Surgeon, January 29, 1814; in 1815 he was on leave in England for two months without pay; on May 17 he was promoted 1st Surgeon of the Army; from March to September, 1820, he was again on leave in England with half pay. He was on active service 1 year, 5 months, 15 days.

John Bolman.—He was probably the first British Surgeon on service with Portuguese troops. As Assistant Surgeon of the Loyal Lusitanian Legion, organized by Colonel Robert Wilson, his name appeared in the Books of the Treasury, dating from November 25, 1808. He was promoted Brigade Surgeon by his Brigadier on January 1, 1809, and Surgeon-Major of the Legion on January 1, 1809. His promotion was confirmed by the Decree of May 16, 1810. By Orders dated April 11, 1811, he was nominated temporarily Brigade Surgeon for the Brigade composed of the 5th Regiment of Infantry and the 5th Light Battalion, without losing his position in the Legion. He was killed during the Battle of Albuera.

Francis Burrows.—Promoted Surgeon-Major in the Army (Chief Surgeon) on July 24, 1813. He returned to service in the British Army October 1, 1814.

John Callender.—Proposed for the rank of Brigade Surgeon in a letter from Beresford to the Portuguese Regency, February 19, 1810. He was appointed on March 10 for the Brigade composed of the 5th and 8th Cavalry Regiments. Promoted Army Surgeon, January 29, 1814. He returned October 1 to the British Army.

John Clark.—He was already on service in the month of November, 1810. In November, 1813, he had two months' leave to England. He was at this time Surgeon of the General Cavalry Depôt. Promoted Army Surgeon, January 29, 1814, and Chief Surgeon of the Army on May 17, 1817. He was on active service for 4 years and 9 months. In 1826 he was decorated with the medal of the Peninsular War. Appointed Deputy Inspector-General January 29, 1836; retired January 29, 1836, and served in the Portuguese Army after retirement.

John Coates.—The name of this Surgeon appears in the Books of the Treasury of March 1, 1812, until the end of March, 1813.

S. W. Clarence.—Appears in Orders of October, 1814, amongst the Surgeons who returned to the British Army.

Lewis Evans, M.B.—He was already in service in the month of March, 1813. On May 21 he was with the Brigade composed of the 8th and 12th Infantry Regiments. Promoted Army Surgeon, January 29, 1814, and returned to the British Army on October 1. He is the only Surgeon that I have come across with the medical qualification, being stated.

Dr. William Fergusson.—Orders of February 23, 1810, appointed Dr. Fergusson as Inspector of Military Hospitals. At that time he was Physician Major of the Army, and the responsibility, relations and authority which he had remained the same as they were. By Orders of March 13, 1813, he was recognized as Inspector-General of Hospitals. This place existed in the Portuguese organization and was not created by Beresford. Fergusson is the only one of the British Surgeons who was given the title of "Dr." in Army Orders. He also returned to England in 1814.

John Griffith.—Nominated for the rank of Brigade Surgeon on February 19, 1810. He appears in the Books of the Treasury from April, 1810, to December, 1811.

Sir Andrew Halliday.—I have found no reference to this Surgeon except on the Pay Rolls from February to June, 1811. He is the author of a work published under the title "The Present State of Portugal under the Portuguese Army." This book went through a first edition in 1811 and cannot now be found in the bookshops in Portugal. Only the second edition of 1812 is available. The first edition was much criticized in the Portuguese Journal published at that time in London: "O investigador portugues em Inglaterra" Volume II. He was appointed Deputy Inspector-General on July 29, 1830.

Hanzkerbury.—As Army Surgeon he appears in the List from July to September, 1815. I have found no other references in spite of the fact that he remained in Portugal after 1814.

Patrick Hughes.—In Army Orders of February 16, 1813, he is given leave of two months to go to England. He was Brigade Surgeon for the 8th and 12th Infantry Regiments. Promoted Army Surgeon, January, 1814. He returned to the British Army on October 1.

Frederick Jebb.—Already on service on April, 1810; he was promoted Army Surgeon, January 24, 1814, and Chief Army Surgeon, March 17, 1817, and he retired July 27, 1826, with the rank of Lieutenant-Colonel and a third of his pay. He was on active service for 4 years, 8 months, 5 days and received the Peninsular War medal.

Edward Keating.—On service in 1810.

Alexander Kendall.—Brigade Surgeon; was promoted Army Surgeon January 29, 1814, and returned to service with the British Army in October.

John Constantine Laisne.—Brigade Surgeon in April, 1810; he went to England on leave for two months in November, 1812. He was promoted Army Surgeon January 29, 1814, and returned to service in the British Army in October.

Larsin.—Brigade Surgeon.

Alexander Lesassier—later Hamilton. Surgeon of the 8th Brigade on June 3, 1813; promoted Army Surgeon January 29, 1814. In Army Orders of March 26, 1814, his activity is praised and the excellent measures for the dressing of the wounded. He left the service of the Portuguese Army on October 1, 1814.

William Maiben.—Brigade Surgeon in the Brigade formed by 6th and 18th Infantry Regiments in 1812.

Patrick MacGlashan.—Brigade Surgeon in 1813; promoted Army Surgeon on January 29, 1814. He returned to service with the British Army on October 1.

David MacLagan.—Appointed Surgeon of the Brigade formed of the 11th 14th Infantry Regiments (9th Brigade) in February, 1813. Cited in Army Orders of November 28, 1813, for the zeal and fortitude shown in the treatment of all the wounded, whom he conveyed and sheltered in a neighbouring house (at the Battle of Nivelle). Promoted Army Surgeon January 29, 1814, but returned in October to service with the British Army.

Melinger.—The name of this surgeon figures in the list of wounded at the Battle of Alcantara on May 11, published in Army Orders of May 27, 1809. As a section of the Loyal Lusitanian Legion took part in this battle, possibly this surgeon belonged to the Legion.

George Morse.—Brigade Surgeon; promoted Army Surgeon on January 29, 1814.

Henry Robertson.—Army Orders of December 22nd, 1810, giving eight days' sick leave on medical grounds. He was Brigade Surgeon for the 9th and 21st Infantry Regiments.

William Robson.—Surgeon of the 5th Brigade in 1812. On September 22, 1813, the Medical Council of the Victoria Hospital gave him forty days' sick leave.

J. Schetky—Appointed in December, 1812, Brigade Surgeon for the 7th and 19th Infantry Regiments. Promoted Army Surgeon January 29, 1814. He returned to service with the British Army on October 1.

Joseph Taylor.—Brigade Surgeon 1812; promoted Army Surgeon January 29, 1814; left the Portuguese service on October 1.

William Thomas.—Appears as Surgeon in the Books of the Treasury, but without any other indication.

Philip Walter.—Brigade Surgeon for the 2nd and 14th Infantry Regiments on January 7, 1813. Promoted Army Surgeon on January 29, 1814; returned to service with the British Army October 1, 1814.

Sir Augustus West.—Appointed Brigade Surgeon on January 13, 1810, and Army Surgeon January 29, 1814, and Chief Surgeon of the Army May 17, 1817. Deputy Inspector-General November 18, 1824. He was in Brazil with Beresford in 1820; he was decorated with the Peninsular War medal and retired on February 14, 1826.

William Wynn.—Appointed in January, 1810: he was Surgeon at General Headquarters. Army Orders of September 9, 1813, praise his services during the last three years. He had at this date the rank of Brigade Surgeon and the title of Hon. Surgeon to His Royal Highness. He was promoted Army Surgeon January 29, 1844, and Deputy to the Chief Surgeon on December 17, 1815. He accompanied Beresford to Brazil in 1815. The rank of Deputy to the Chief Surgeon did not exist in the Portuguese Army, and I think that it was given to Wynn during his stay in Brazil. Wynn died on November 13, 1821. I believe that Wynn's family remained in Portugal. On September 20, 1834, John Beresford Nanny Wynn was admitted to Matriculation in the first year of the Surgical Course at the Hospital of St. Joseph. He was a native of Lisbon and the son of William and Isobel Wynn.

Westcortt.—Brigade Surgeon in the month of August, 1815.

Current Literature.

MACGRAITH, B. G. **The Diagnosis of Meningococcal Meningitis from the Spinal Fluid.** *Lancet*, 1934, i, 17.

The author summarizes recent methods of identification of the meningococcus on which he has been working, and hopes they will be more fully investigated by others.

(1) METHODS OF IDENTIFICATION OF THE ORGANISM.

(*a*) The use of antimeningococcal serum agar plates.

Preparation of the Medium.—Five per cent antimeningococcal horse-serum made from Types I to III meningococci and free from preservative is added to a warm solution of 2·5 per cent agar, pH 7·6, just before the agar begins to solidify and plates are poured, about 15 cubic centimetres of the medium being used for each plate. The further addition of 3·5 per cent normal rabbit blood, laked with glycerin or water, at the same time as the serum makes a clear red medium on which the meningococci grow with great rapidity.

Method of Test.—The centrifuged deposit from the cerebrospinal fluid is smeared direct on the medium or else on to Dorset's egg medium and transferred later as a stab inoculation to the anti-serum agar plate, which is incubated for twelve to twenty-four hours at 37° C.

If the organism is a Type I-III a faint white halo will develop in the medium round the growth. Types II and IV have not yet been found to produce a halo.

(*b*) Direct slide agglutination of the organisms.

A fairly dense saline emulsion of the organisms is made from the anti-serum agar medium and is set up on slides against the four stock diagnostic rabbit anti-sera.

Incubation for 20 minutes at 37° C. under moist conditions is usually sufficient. Agglutination may occur in more than one serum, but usually one slide is more affected than the others. Slide agglutination is not always reliable as organisms on first isolation often fail to agglutinate.

(2) Tests on the Spinal Fluid Direct.

(*a*) Precipitation with antimeningococcal serum.

Technique.—Set up two rows of four Dreyer agglutination tubes and two control tubes. Four different dilutions of the spinal fluid are used, 1:1, 1:4, 1:16, and 1:64. Eight drops of fluid are added to each tube, the front and corresponding rear tube of each row receiving the same dilution of fluid. Into each of the four front row tubes place two drops of undiluted polyvalent anti-serum and into the rear row place two drops of serum diluted 1 : 4. Control tubes of undiluted spinal fluid and of undiluted serum are put up in saline. The tubes are shaken and the series incubated in the water bath at 37° C. from eight to twenty-four hours. Only definite precipitation is positive. Clouding without precipitation is not diagnostic. The second day of disease appears to be the earliest on which a positive precipitin reaction can be obtained.

(*b*) The fixation of complement by spinal fluids.

Spinal fluid when put up with polyvalent antimeningococcal horse-serum gives a positive complement fixation reaction. The spinal fluid was put up in dilutions of 1 : 1, 1 : 8, and 1 : 32.

A combination of the polyvalent precipitin reaction and the growth of the organism on animal serum-agar plates seems to be the quickest method of diagnosing meningococcal infections from the examination of spinal fluids.

H. T. Findlay.

Benson, O. O., Jr. **Tear Gas Taken Internally.** *The Military Surgeon.* 1934, lxxiv, 96.

A white soldier, aged 27, with six years' service, who had attempted to kill himself in 1927 by shooting himself through the left temple with a revolver, again attempted to commit suicide by swallowing a one gramme gelatine coated capsule of chloracetophenone (tear gas). These capsules are marked with the letters "CN" and were mistaken by the man for "cyanide."

About five minutes after the capsule was swallowed severe epigastric

pain came on, followed by vomiting, the man writhing in pain on the ground. He was admitted to hospital in about twenty minutes and his stomach was washed out with about six gallons of water. The pain disappeared in about two hours, and the only abnormal sign was some congestion of the mucous membrane of the mouth and pharynx and of the conjunctivæ. The absence of general symptoms is considered to be due to the fact that chloracetophenone is insoluble in water and weak acids. The compound is soluble in alcohol and is destroyed by 60 per cent sulphuric acid and by a hot solution of sodium carbonate.

A. H. Fletcher, F.A.P.H.A., and E. C. Link. **Some Factors Involved in the Use of Chloramines for the Disinfection of Swimming Pools.** *American Journal of Public Health.* 1933, xxiii, No. 12, pp. 1255-1261.

Bacterial counts of the waters of swimming pools collected and tested in the usual manner are compared with those samples treated with antichlors to prevent the action of chloramine continuing during transit to the laboratory. It is recommended that one millilitre of 1·5 grammes of crystallized sodium thiosulphate per litre should be placed in sterile bottles, and the whole re-sterilized in an autoclave for five minutes at fifteen pounds pressure. The samples should then be collected in these bottles. Sodium thiosulphate was recommended as the best antichlor as it withstands sterilization.

The amount of sodium thiosulphate, while destroying the sterilizing effect of the usual quantity of chloramine (not exceeding one part per million) in swimming bath water, did not have any effect on the bacterial count. Certain extra tests and controls are required when swimming bath water is treated with chloramine: (1) A higher residual amount of chloramine (0·7 to 1 part per million) is required than with chlorine. (2) A control of the ratio of chlorine to ammonia is required, a dose of 4 to 1 is necessary for the first few days after refilling and then a ratio of 10 to 1 of ammonia. (3) The reaction of the water should be controlled. (4) All samples should be collected in bottles treated as above with sodium thiosulphate.

Copper sulphate in a proportion of 5 pounds to 100,000 gallons of water, added every second night, effectively checked agal and slime growths in the bath.

S. Elliott.

Vernon, H. M. **The Temperature Gradients Induced by Various Heating Systems.** *J. Inst. Heating and Ventilating Engineers.* 1933, v. 1, 312-20, 4 figs. [15 refs.]

The author gives two reasons for avoiding a rising temperature gradient from floor to ceiling—the discomfort caused by this condition, and the extra loss of heat taking place through the upper parts of a building where the air under the ceiling is unduly hot.

A rule-of-thumb method that has been used to estimate the extra heat that should be provided to allow for this loss is shown not to hold good for all methods of heating, because some methods cause greater temperature gradients than others.

Figures and curves are given for a number of observations on different heating installations and the conclusion is reached that the best methods of heating by pipes or radiators is that where the ascending currents of warm air from the heating surfaces meet and balance descending currents of cool air from walls and windows. The worst systems are those in which powerful, hot convection currents ascend, unimpeded, to the ceiling. The remedies are to use heaters of greater length than height, to place radiators low down and under the colder parts such as windows, and perhaps to cover the tops of radiators with some kind of a baffle.

Warm air or "hot blast" heating systems are particularly liable to produce adverse temperature gradients, even if the inlets are placed low down.

In heating the rooms of dwelling houses closed coke or anthracite stoves give rise to steeper temperature gradients then open fires, coal or gas.

Low temperature panel heating is good in this respect and medium temperature panel heating (500° F.) less good.

T. C. ANGUS.

Reprinted from "Bulletin of Hygiene," Vol. 9, *No.* 1.

HOUGHTEN, F. C., and BLACKSHAW, J. L. **Indices of Air Change and Air Distribution**. *Heating, Piping and Air Conditioning.* 1933, v. 5, 324-30, 5 figs.

Although the significance of carbon dioxide concentration, *per se*, in the air of buildings, has long been recognized to be of negligible value as a standard of ventilation, the fact that this gas is evolved continuously and in known quantities by persons still makes it a valuable indicator of the general efficiency of ventilating systems to change and redistribute the air—thus indirectly giving us an indication of less easily measurable quantities, such as bacterial concentration and unpleasant odours.

The authors contend that as water vapour as well as CO_2 is given off in known amounts by the occupants of a room, and as it requires much less elaborate and more easily used apparatus to measure water vapour, measurement of the change of water vapour content of the air may well be substituted for that of CO_2 in routine ventilation work.

A chart (which can be used directly to determine the air changes actually taking place) is given, showing the CO_2 concentration, changes of water vapour content, and changes of dry and wet bulb thermometer readings produced in the air of inhabited spaces. It is shown that if at 70° F. dry bulb temperature a wet bulb temperature change of 0·4° F. can be more easily determined than a CO_2 change of 1 part in 10,000, the moisture

content method is the better measure of air change or air distribution, assuming of course that the moisture dissipated to the atmosphere is retained therein to the same extent as the CO_2. This last provision is believed to be true except where some part of the enclosure (such as a window) is sufficiently cold to produce much condensation.

Tests in the psychometric chambers of the Research Laboratory of the American Society of Heating and Ventilating Engineers, Pittsburgh, show that a greater consistency of results is obtained by measuring the water vapour content than by measuring the CO_2 content.

T. C. ANGUS.

Reprinted from "Bulletin of Hygiene," Vol. 9, No. 1.

Reviews.

REPORT OF THE SURGEON GENERAL U.S. ARMY TO THE SECRETARY OF WAR, 1933. Washington : U.S. Government Printing Office, 1933.

In the Annual Report, 1933, the Surgeon General deals with vital statistics for the year 1932, and with general matters pertaining to the Medical Service for the financial year which ended in June 1933.

The strength of the Army in 1932 was 131,925, there being 11,693 officers, 109,234 white enlisted men and 3,545 coloured enlisted men, the remainder being Filipinos and Puerto Ricans. Seventy-three per cent of the troops were stationed in the United States.

Health was satisfactory during the year, the admission rate being 680 per 1,000, compared with 651 in 1931 and 608 in 1930. An epidemic of acute respiratory disease, with a low mortality rate, in December, 1932, caused a considerable increase in the rate.

The main causes of admission to hospital were influenza (8,759), bronchitis (4,472), athletic exercise (3,386), gonorrhœa (3,348), acute tonsillitis (2,569), pharyngitis (2,508), rhinitis (2,460), chronic tonsillitis (2,376), falls (2,000), enteritis and colitis (1,821), cellulitis (1,570), and syphilis (1,509).

Admissions for venereal diseases (42 per 1,000) were the lowest ever recorded, but they are still the greatest cause of loss of time off duty. In China, with a strength of about 1,200 white enlisted men, the admissions for venereal diseases were 102 per 1,000.

For the last two years experiments have been made in the use of hexylresorcinol as a preventive of gonorrhœa, a 25 per cent solution being used, 33 per cent having been found to be too strong. This chemical has been found to be as effective as protargentum, and has the advantage that it does not stain clothing.

Malaria was responsible for only 616 admissions, the admission ratios in Panama being 31·9 per 1,000 and in China 90·8 per 1,000. The Medical

Department Research Board carried out work on solar ultra-violet radiometry, a report of which will be published in the *Philippine Journal of Science*, also researches on surra, amœbiasis and yaws.

The full strength of officers in the Medical Corps is 983, the numbers in the various ranks being: Major-General, 1; Brigadier-Generals, 2; Colonels, 75; Lieutenant-Colonels, 98; Majors, 551; Captains, 137; Lieutenants, 91. Full strength was maintained until October when there were 25 vacancies. Of 14 internes (recent medical graduates) trained in Army hospitals, 9 qualified for appointment in the Regular Corps, and 26 civilian candidates, who qualified by examination for admission to the Reserve Corps, were called up for a period of not less than six months active duty, at the end of which it was intended to re-examine them for admission to the Regular Army.

The remarks made by the Surgeon General in his letter of transmission are of interest. He writes: "Prior to the passing of the Economy Act in the latter part of the year candidates for the Regular Corps were placed on duty under reserve commissions, and after a six-month period of observation were reported on as to suitability and adaptability for commissions in the Regular Army. These officers were paid out of Veterans' Administration funds during this probationary period; but since such funds are no longer available, admissions to the Regular Corps from civil life must be made directly. Early in the present century it was decided that before any contract was entered into with a candidate for commission in the Medical Corps he should be given a period of observation to determine his fitness for service in the Army. Suitable legislation was passed with this end in view and proved very satisfactory for many years. A revival of this method is now the subject of study and will be reported upon later."

Commissioned personnel in the Medical Department Reserve Corps numbered 11,936, the numbers in the various ranks being: Brigadier-Generals, 3; Colonels, 334; Lieutenant-Colonels, 851; Majors, 1,744; Captains, 2,222; First Lieutenants, 6,782; and, in addition, a great many appointments were made in the last month of the year.

The strength of enlisted men in the Regular Corps was 6,523, of whom 591 were detailed to the veterinary service; this strength represents 5 per cent of the actual strength of the Regular Army, but the Surgeon General considers that the proportion is too small and that it should be raised to 7 per cent.

PRACTICAL POINTS IN EYE SURGERY AND DRESSING. By Hugh E. Jones, M.R.C.S., L.R.C.P. London: John Bale, Sons and Danielsson, Ltd. 1933. Pp. 27. Price 2s. 6d. net.

The scope of this booklet of 27 pages is summarized in the author's introductory paragraph, "This little book is neither an abridged textbook nor an examination cram-book, but comprises an attempt to provide

answers promptly to some of the innumerable questions which arise to puzzle the inexperienced nurse or house-surgeon who has just begun to work in the eye department of a general hospital, or even the general practitioner who has charge of eye cases in a cottage hospital or nursing home, and so to prevent harmful first aid and to ensure helpful preparation for operations."

The book covers a very limited field, is entirely practical, and should be of value to those for whom it is written.

J. B.

BACTERIOLOGY FOR MEDICAL STUDENTS AND PRACTITIONERS. By A. D. Gardner, D.M., F.R.C.S. Oxford University Press. London: Humphrey Milford. 1933. Pp. 276. Price 6s. net.

In the preface the author says that his aim has been to present shortly, readably and relevantly as much of the vast subject of bacteriology as a medical student or practitioner needs to know and we congratulate him on his success. The book is remarkable for the amount of interesting information that it holds; it is thoroughly up to date and leaves out nothing of importance. Protozoal diseases, viruses, bacteriophage, immunity, all are dealt with. There is a final chapter on hygiene. To get so much into a small pocket book, in such a readable form, is a great achievement. We can see little to criticize. There is a mistake on p. 201, where it refers to the carrier "mosquito" of trypanosome infection, but it is the only slip we have been able to find. The book can be thoroughly recommended to all officers of the Corps.

A. C. H. G.

HAIG. By Brigadier-General J. Charteris. London: Gerald Duckworth and Co., Ltd. 1933. Pp. 144. Price 2s. net.

An interesting volume in Messrs. Duckworths' modestly priced Great Lives series is "Haig."

In the first four chapters General Charteris has succeeded in giving a very clear picture of the early life of Field Marshal Haig, of his methods of working, his experiences in India, at Aldershot and in the War Office, and on active service in the Sudan and in South Africa. This part of the book might be described as dealing with the making of Haig.

The largest part of the volume covers the period of the Great War, and we see how the great soldier came to regard himself as being almost divinely set apart for the task which he successfully accomplished.

In the last few pages we read of the visit of homage to the then discredited Lord Haldane, whom he described as "the Greatest Secretary for War England has ever had," and of Lord Haig's devotion of the remaining years of his life to the cause of the ex-Service men.

The book is so finely written that one lays it down with the feeling that one has just read a large history.

A short bibliography is appended to the volume.

Notices.

LIST OF BOOKS RECEIVED AT THE ROYAL ARMY MEDICAL COLLEGE LIBRARY DURING THE PERIOD JUNE 1 TO DECEMBER 31, 1933.

Author(s)	Title of Work	Grant or Not
Franz & Gordon..	Psychology	Grant
Bankart ..	Manipulative Surgery	,,
Practitioners	Library. Vol. IV	,,
Bales	What the Diabetic Needs to Know about Diet	,,
Ward	General Practice ..	Lt.-Col. Heatly Spencer
Maingot ..	Management of Abdominal Operations	Lt. D. A. Beattie
Thresh & Beale..	Examination of Water and Water Supplies..	Grant
Lawrence..	The Diabetic Life	,,
Ward & Smith ..	Recent Advances in Radium	,,
Smith	Atlas of Skin Diseases of the Tropics..	,,
Fisher	Internal Derangements of the Knee-joint	,,
Bickerton & Savin	Clinical Ophthalmology..	,,
Woolf	Anatomy of the Eye and Orbit	,,
Cannon	Hypnotism	,,
Clay	Sanitary Inspector's Handbook	,,
Martin	Food Inspection. Vol. II	,,
Kerr & Ferguson, &c.	Obstetrics and Gynæcology	,,
Lewis	Urology of Women	,,
Boas & Goldschmidt	The Heart Rate..	,,
Cobb	Organs of Internal Secretion	,,
Williams ..	Minor Maladies and Their Treatment	,,
Cushing ..	Intracranial Tumours ..	,,
Peters and Van Slyke	Quantitative Clinical Chemistry. 2 vols.	,,
Blake	Drainage and Sanitation	,,
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Date and Time	Place	Lecturer	Subject	Chairman
May Tuesday, 8, 5.30 p.m.	Hall of the Royal Society of Tropical Medicine and Hygiene, 26, Portland Place, W.1.	Dr. Jane Walker, C.H., J.P., LL.D.	Village Hygiene Water Supply Disposal of Refuse	Sir James Crichton-Browne, M.D., F.R.S., Chadwick Trustee
Tuesday, 29, 5.30 p.m.	The Royal United Service Institution Whitehall, S.W.1	John Boyd Orr, D.S.O., M.C., M.A., M.D., D.Sc.	The National Food Supply and Public Health	Sir Matthew G. Wallace, Bt. Chadwick Trustee
June Thursday, 14, 5 p.m.	Chelsea Physic Garden, Swan Walk, Chelsea	E. Augustus Bowles, Esq., M.A., F.L.S.	Simples and Herbals Illustrated by Living Plants	Sir William J. Collins, K.C.V.O., M.D., M.S., F.R.C.S., B.Sc. Chairman of the Chadwick Trustees

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No. 5. May, 1934. Vol. LXII.

Journal of the Royal Army Medical Corps

IN ARDUIS FIDELIS

ISSUED MONTHLY

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Price Two Shillings net

VOL. LXII MAY, 1934. No. 5.

Journal
of the
Royal Army Medical Corps.

Original Communications.

PACKET SYSTEM OF STERILIZATION.

BY MAJOR-GENERAL J. W. WEST, C.M.G., C.B.E., K.H.S.

THIS subject has been under consideration for some time, having been first raised in 1931 in a paper by Major Frobisher, R.A.M.C. [1]. He suggested that the packet system should be adopted in the Army. His paper aroused considerable interest, as there would be a great saving in bulky material if the large number of sterilizing drums could be eliminated from the medical mobilization equipment. In peace time these drums are a constant source of recurring expenditure, as damage to the hinges and clasps is very common, and in most hospitals scarcely a week passes without some of these drums having to be sent for repair.

I have often used a packet method of sterilization in stations abroad where drums were not available, the dressings, etc., being simply enveloped in towels or a sheet and sterilized in a high-pressure dressing sterilizer. Many other officers must have tried this system and, with care, satisfactory asepsis has been secured.

The packet method has been given a trial in the Queen Alexandra Military Hospital, Millbank, and at the Cambridge Hospital, Aldershot. Neither of these hospitals was satisfied that the method is completely satisfactory for use in the Army.

The criticisms advanced from the Queen Alexandra Military Hospital were shortly as follows :—

(i) The packet method is only suitable for wrapping up small quantities of dressings.

(ii) The packets are unwieldy in the wards and a large table space is required to open and close them.

(iii) Closure of the packets after use is often unsafe, as the tapes, which have possibly touched non-sterile articles, might come in contact with the dressings.

(iv) The method is not so convenient as drums for hospital work, but might serve for active service.

The report from Aldershot was slightly more favourable, but also contained certain criticisms, viz. :—

(i) The method is not suitable for use in the operating theatre, but may be useful in wards and on active service.

(ii) It requires more care in use than drums.

(iii) Partially trained or untrained personnel could not safely use the packets.

(iv) The packets are too large for dressing trolleys.

Inquiries showed that the method is not adopted in any of the London civil hospitals. I thought that if it were a satisfactory method and effected a financial saving compared with sterilizing drums and their upkeep, many hospitals would make use of the method. Consequently a letter was sent to the House Governor of the Leeds General Infirmary asking if it was the only method in use there and for particulars of the technique. The House Governor replied that it was the only method in use in the Infirmary and suggested that a representative should visit Leeds to see the procedure. On November 17, 1933, therefore, I visited the General Infirmary, Leeds, and was received by the House Governor and the Senior Surgeon to the Hospital, Mr. H. Collinson, F.R.C.S. The senior sister-in-charge of the operating area had kindly prepared a demonstration of the method and took great pains to describe fully the procedure. The method of using the packets in the wards was also demonstrated by a ward sister, and Mr. Collinson explained many of the details.

Description of the Leeds Method of Packet System of Sterilized Dressings.

Some of the technique is difficult to describe in words and must be seen to be appreciated.

All packets for the wards and operating rooms are prepared in a special department adjoining the operating area. Four lady nurses are constantly employed in a large room. This room, in addition to tables and benches, has a long range of cupboards with many shelves and close-fitting glass-fronted doors, and also many labelled drawers for storing packets which have been sterilized. No attempt is made to provide large packets containing all that would be required for an operation, such as gowns, towels, dressings, swabs, etc. The principle is to have a large number of small packets; thus gloves are in one small packet, tetra cloths in another small packet, one dozen abdominal packs in another. The largest packet con-

sisted of three sheets to cover the patient on the operating table. The packet for the surgeon's preparation is also small. Short coats without sleeves are used, and one of these with a pair of trousers constitutes a packet. Another small packet contains a pair of sleeves.

No large packets are supplied for the wards, the idea being rather to prepare an individual packet for the dressing of one case. Quite a small packet designed for the preparation of a case for operation was demonstrated in the wards.

How the Packets are Made Up.

The larger packet has a cover consisting of a sheet of jean material lined with a layer of flannelette, the two being stitched all round the edges. The materials to be sterilized are placed in the sheet and are never more numerous than can be amply covered by it.

The method of folding that has been found to be most useful is to turn in the corners to the centre, overlapping slightly, and then to fold the packet once on itself. It is kept closed by being tied all round with a strip of bandage. There are no attached tapes.

For the smaller packets containing swabs and gauze dressing, the pads are rolled up in a piece of flannelette and then enclosed in a jean cover as described, and the corners are turned in and tied up.

Storage.

The packets for operating room use are kept in the cupboards and drawers mentioned, and the packets required for an operation are withdrawn as necessary.

Method of Using the Packets in the Operating Room.

The technique must be seen to be understood, but is shortly as follows :—

In the operating room there is a very large semicircular stand with shelves. On the top shelf a series of large sterilized basins is arranged and kept ready for use covered by a sterilized sheet.

When an operation is about to take place the sister opens a packet. She cuts and removes the enclosing bandage, grasps the material with both hands on either side, and by supinating the forearms makes the outer cover with its turned-in corners gape and then decants the contents, in some cases enclosed in an inner wrapper as described, into one of the sterilized bowls. After this the dressings, swabs, etc., in the bowls are only handled by sterilized gloved hands or sterile forceps. When more swabs, etc., are needed, a fresh small packet is opened and decanted into the appropriate bowl.

The largest packet employed contains sheets to cover the patient. Three small sheets are placed in each packet, one having an opening through which the operation is performed.

For the preparation of the surgeon a sterile table is prepared by covering it with sterile towels removed from a packet by forceps; the coat and

trousers, and in some cases linen long boots, are decanted on to the sterile table by the method described.

It will be noted that no packet is opened and then closed again and that no attempt is made to have a series of things, such as towels, sheets, dressings, swabs, etc., made up in one packet.

Storage and Use in the Wards.

Very large enamelled dressing boxes are provided for each ward and the required packets, which are all small and drawn twice daily, are kept in these and withdrawn as required. The sister demonstrated their use. The same method of opening the packet is employed. The bandage is removed, the outside of the material grasped by both hands and the folded-in corners made to gape; the packet is then placed on the dressing table which is quite small and the contents picked out with sterile forceps. It is usual for a fresh packet to be used for every dressing and preparation.

Length of Time Kept After Sterilisation.

The wards practically use up their supply daily, but no anxiety is felt about the sterility of the contents of packets which may not be used for several days. In the operating area the sister informed me that three days was the greatest period that a packet was likely to remain before being turned over, but no anxiety would be felt if it remained for a week.

It should be noted that both in the operating area and in the wards the packets are carefully kept under cover from dust, etc.

It should have been mentioned that large cotton bags labelled for wards, etc., are provided; into these all the packets for a ward are placed. Each bag is closed with a draw string and in it the packets are sterilized and then delivered where required.

Surgical Opinion of the Value of the Method at Leeds.

The surgeons and sisters are completely satisfied that aseptic surgical conditions are fully ensured by the methods employed. Frequent laboratory tests are employed and are uniformly satisfactory.

Cost of the Method.

As drums are never used at Leeds the staff are not in a position to compare the two methods, but a very large quantity of material is required to supply all the packets used and daily replacement of the packet material is necessary.

It appeared to me that the recurring cost may be quite as great as the repair of drums, but the initial capital cost is much less.

Comparison of the Leeds' Method with the Procedure Tried Out at the Queen Alexandra Military Hospital, Millbank, and the Cambridge Hospital, Aldershot.

After visiting Leeds it was at once clear that the trial we conducted did not in any way conform to the practice at Leeds. At London and Aldershot the packets were all too large, and too many different things

were put into one packet. Further, it was assumed that a packet could be employed for a whole series of ward dressings and safely closed again between such dressings. The packets were much more elaborate affairs than the Leeds packets and had attached tapes for tying.

The criticisms on the method are due to these causes and will be obviated if the true Leeds technique is adopted.

Is the Method Applicable to the Army.

If a method has distinct advantages in war it might be justifiable to adopt it in peace, but no method must be used in war which is not practised in peace.

There is no doubt that an individual surgeon could train his operating staff to use the method safely and successfully.

The success of the method at Leeds depends on the fact that the drum method is never employed. The whole staff of the hospital, probationer nurses, nurses and sisters, have never used any other method and fully realize how these packets are to be handled. This handling is comparable to a laboratory technique which can only be successfully employed by fully trained personnel. In the Army we would be constantly confronted with medical officers and lady nurses drawn from teaching schools where the method has not been tried and who are opposed to it from the first. Unlike a civil hospital, changes of nursing staff in a military hospital are very frequent and in the wards orderlies who are undergoing training and have not yet grasped the full significance of aseptic surgery may have to handle these packets. In these conditions the method would be unlikely to give satisfactory results, and the responsibility of the surgeon would be greatly increased.

If it is decided that the method is not suited for use in peace, it is certainly not suited for use in the field. Here a mixed staff, many of whom had never heard of the method, would certainly fail to secure asepsis and the number of individual packets required would be impossible of attainment. The careful storage of the packets before use, which is practised at Leeds, might not be possible at General Hospitals and Casualty Clearing Stations on active service.

To Sum Up.

The method is safe in an individual hospital where the staff is permanent and educated up to it from their earliest training.

It is not really suitable for use in the Army with a staff who have been trained in other methods and with many partially trained men working in the wards.

As I pointed out in previous correspondence on this subject, if the method were entirely satisfactory and effected a financial saving, many London hospitals would be using it and it would not be confined to the Leeds General Infirmary.

REFERENCE.

[1] Journal of the Royal Army Medical Corps. 1931, lvii, 119.

HÆMOGLOBINURIA: A NEW PROBLEM ON THE INDIAN FRONTIER.

By Lieutenant-Colonel A. C. AMY, D.S.O.,
Royal Army Medical Corps.

(*Continued from p.* 278.)

1933.

We now come to a collection of cases from a big headquarters station, where there are well qualified specialists and an excellent laboratory at the call of the ward medical officers.

All five patients were resident in Quetta, and all developed hæmoglobinuria within a period of ten days, viz., between August 3 and 12, 1933. At this time Quetta was being visited by an epidemic of benign and malignant malaria of more than usual severity and extent.

The outbreak was isolated. No cases of this kind occurred prior to August 3, and no such cases have occurred since.

Before describing the cases in detail, it is convenient to say something now, firstly, about idiosyncrasy, individual and racial; and secondly, about batch toxicity of plasmoquine. These remarks may also be borne in mind when considering the cases (patients 1, 2, 3, 9 and 10) which occurred sporadically in stations other than Quetta.

Prior to the Quetta outbreak, it was thought that, if the 1932 hæmoglobinurias were not true cases of blackwater fever, they must have been plasmoquine idiosyncrasies.

"Does a race susceptibility exist? It has struck us as rather peculiar that the number of severe cases of toxæmia seen during our researches seems to be higher than those recorded in many instances by other workers using the same dosage. The population in our researches was an unusually healthy one, and except for occasional relapses of chronic malaria, the majority were apparently quite fit in the intervals, so the toxæmia could not be accounted for by any evident physical weakness. Our patients were all of northern European origin, as were also the severe cases of toxæmia reported by Wade (1929), Ashby (1928), and Squires (1928), and the first author notes specially that he has not observed similar symptoms among Indians receiving the same treatment. When one considers the enormous daily doses, even as high as 0·32 gramme, given by some workers to the inhabitants of southern Europe and of the tropics with few or no recorded severe ill-effects, while severe toxæmia or even death has been recorded in other places after doses as low as 0·06 gramme daily, one is tempted to think that such a racial susceptibility may exist and that possibly it may occur more commonly in persons of northern European origin than among others" [45].

The cases now under review, and our annual and special reports regard-

ing the treatment of malaria patients with synthetic drugs show that, in military medical practice in India, the above opinion cannot be accepted. The matter may take on a different aspect when the result of the recent reduction of Indian dosage, from 0·03 (the present British dose) to 0·015 gramme daily, manifests itself. But it will be noticed that, in the above quotation, Wade notes specially that he has not observed similar symptoms among Indians receiving *the same treatment.*

That is in direct conflict with our findings.

But individual idiosyncrasy is a different thing from racial idiosyncrasy; and when it is remembered that, in August, 1933, hundreds of patients, British and Indian, all over the Peninsula, were receiving plasmoquine without toxic effects, it is impossible to believe that five very susceptible persons, all of the same nationality, developed malaria in one place, Quetta, and were there poisoned within the short space of ten days. Such a combination of uncommon circumstances is incredible.

So, while the possibility of racial susceptibility and the probability of individual idiosyncrasy comparable to "quinine intolerance" are accepted as reasonable propositions, it is safe to say that, in the Quetta series, the question of idiosyncrasy need not be considered at all.

The five Quetta cases might possibly be explained on the assumption that, as they were stricken in the same place and at the same time, they may have suffered from some antecedent disease which gave rise to disturbance of liver function, lowering of the alkali reserve, etc., and may thus have become predisposed to acute plasmoquine poisoning.

There was no evidence of any such precedent condition.

The patients came from different units, located in different parts of the cantonment. Three were Mussalmans and two were Hindus, and they belonged to different walks of life. In these important respects the absence of any common factor is striking.

As regards batch toxicity or deterioration of the drug: Although the use of plasmoquine was universal throughout India, the rest of the military population was unaffected; and in Quetta, many other patients, British and Indian, were receiving the drug. Tablets from the actual batch which may have poisoned our patients were administered to many other patients without ill-effect, not only before, but *after*, the outbreak. Samples of the consignment have been sent to the makers for toxicity tests. The results are not yet available. Meanwhile there is no reason to suppose that these samples will prove to be anything but innocuous in the small doses in use in military medical practice in India [45].

One other point: as soon as the third case was detected, a different bottle of plasmoquine was taken into use. This did not prevent two more cases from occurring.

Combination of plasmoquine with atebrin has already been dealt with. Combination of plasmoquine with other potentially dangerous drugs, such as the alkylamino group, need not be discussed, since—apart from

symptomatic restorative treatment—none of the Quetta or of the other cases received anything more harmful than simple alkaline mixtures [46].

Case 4.—A Mussalman coolie employed by the Royal Air Force.

Aged 18. Has resided continuously in Quetta for at least ten months.

July 26 to 31.—In hospital, suffering from malaria (benign tertian rings) of six days' duration.

Anæmic. Spleen palpable. Fever only lasted for one day.

Treatment: Atebrin, 0·1 gramme, thrice daily, from July 26 to 30. Total administered, 1·5 grammes.

July 31.—Discharged from hospital, excused all duties, and to attend the medical inspection room daily as an out-patient. To receive plasmoquine, 0·01 gramme in the morning and 0·02 gramme in the evening.

August 2.—Patient re-admitted to hospital, after having received 0·06 gramme plasmoquine spread evenly over two days. Plamoquine discontinued.

Temperature 103° F. Rigor, giddiness, headache, slight cyanosis, profound anæmia, abdominal pain, hiccough and—in the evening—vomiting.

Spleen palpable. Liver not enlarged.

Blood: No parasites. Normoblasts and megaloblasts present. Marked leucocytosis.

Urine: Reaction neutral; heavy content of albumin; some red blood-cell detritus: hæmaglobin.

August 3.—Anuria has set in. A catheter yielded four ounces of very dark-coloured urine.

At 12.30 p.m. temperature was 99·8° F., pulse 120, and the general condition grave. Patient was semi-comatose, and the cyanotic tinge more marked.

3 p.m: Pulse failing rapidly. Slight jaundice has appeared. The liver does not seem to be enlarged.

4.10 p.m.: Death. Post-mortem examination refused.

The laboratory reported on specimens taken on August 3 as follows:—

Blood: Red cells, 1,070,000. Anisocytosis: nucleated reds +++; megalo- and normoblasts +; polychromatophilia ++. No parasites present. White cells, 42,000. Polymorphonuclears, 72 per cent; lymphocytes, 16 per cent; large mononuclears, 6 per cent; enosinophiles, 6 per cent. Hæmoglobin could not be estimated on account of the dark grey colour of the blood.

Urine: Colour, brown-black—like stout; reaction, neutral; heavy amorphous deposit; red cell detritus ++; albumin +++; methæmoglobinuria +.

Unfortunately, at Quetta there is no spectroscope.[1] Methæmo-

[1] Similarly for Fort Sandeman and Wana. There are spectroscopes at Peshawar and Kohat.

globinæmia was presumed on the dark grey colour of the blood (it was impossible to match the specimens with the standard colours of the Tallquist hæmoglobinometer); and methæmoglobinuria on the "stout" as opposed to the port-wine colour of the urine. But for this, we have here a fairly complete and convincing picture, the outstanding features of which seem to be:—

Sudden onset and dramatic swiftness of the attack.

Rapid and massive destruction of the red blood cells.

Methæmoglobinæmia, methæmoglobinuria and anuria.

An attack out of all proportion to the amount of plasmoquine given; and a fatal issue despite the early withdrawal of the drug. Was the drug responsible?

Case 5.—A Mussalman sepoy (a reservist up for training) of the mechanical transport.

Aged 27. Service six years.

August 1.—Admitted to hospital with a history of rigor and fever of one day's duration. Temperature 100° F., falling. Spleen enlarged to 3-fingers, and hard. Liver apparently normal. Blood smear contained malignant tertian rings. Treatment: atebrin, 0·1 gramme, thrice daily.

On August 3 there was a rise of temperature, 100° to 101° F. On August 5 there was a second rise, 99·5° to 100° F. Otherwise, the case pursued a normal course. On the latter date the patient completed his course of atebrin; total, 1·5 grammes, spread evenly over five days.

August 6.—Course of plasmoquine commenced, 0·01 gramme in the evening. Progress maintained on August 7.

August 8.—Morning temperature normal. Pulse 72, and of good quality. Is constipated and complains of abdominal pain. Rectal enema given, with good result. On account of the pain in the abdomen it was thought well to discontinue the plasmoquine. Total amount administered since August 6, 0·06 gramme.

11 a.m.: Cyanosis and jaundice, both slight. No apparent change in the liver. Patient is mentally alert, and feels comfortable.

1 p.m.: Temperature 99·8° F. Pulse 110. Patient passed eight ounces of dark, reddish-brown urine, alkaline in reaction and loaded with a thick amorphous deposit which contained red blood cell debris. No undamaged red cells were seen. Albumin and methæmoglobin were present.

4 p.m.: General condition, fair. Patient again passed about eight ounces of urine of the same characteristics as the last specimen.

Blood: Red cells, 4,930,000. No nucleated forms. White cells, 14,600. Polymorphonuclears, 59 per cent; lymphocytes, 35 per cent; large mononuclears, 5 per cent; eosinophiles, 1 per cent; hæmoglobin, about 95 per cent, but the dirty grey colour of the blood made it difficult—indeed, almost impossible—to match with Tallquist's hæmoglobinometer.

5 p.m.: Temperature 101·2° F. Pulse 116. Patient vomited bile-stained fluid, and passed a tarry stool which gave a positive response to a test for occult blood.

August 9.—Temperature 101° F. at 8 a.m. Patient has had a good night and feels fairly comfortable.

9 a.m.: Bile-stained fluid vomited, and tarry stool passed.

10 a.m: Patient's general condition is deteriorating. Anæmia, profound; cyanosis, distinct; jaundice, slight. Total amount of urine passed in twenty-four hours, 58 ounces.

Blood: No parasites present. Red cells, 1,185,000. One nucleated cell seen. Normoblasts present, of which many have two nuclei; and one with three nuclei was noted. White cells, 38,900. Polymorphonuclears, 56 per cent; lymphocytes, 35 per cent; large mononuclears, 6 per cent; eosinophiles, 3 per cent. Hæmoglobin estimated at about 60 per cent, but matching was again found to be very difficult.

August 10.—Patient's condition as recorded yesterday remained unchanged until 6 a.m. to-day, when a marked change for the worse set in. Pulse hardly perceptible, anæmia intense, cyanosis increased, jaundice moderate. Total amount of urine in twenty-four hours 48 ounces.

12.30 p.m.: Patient died.

Once more the fulminant nature of the illness is illustrated. In a matter of twenty-four hours after the onset of the acute symptoms the red blood cell count drops to 1,850,000; and in another twenty-four the patient dies, although plasmoquine was withdrawn at the earliest sign of complications.

Case 6.—A Mussalman baker, employed for the past eight years at the Government Bakery, Quetta.

Aged 38. Weight, 6 stone 4 pounds. General physique, good. No previous history of malaria elicited.

August 2.—Admitted with signs and symptoms of malaria, of twenty-four hours' duration, and in the course of which the temperature has fallen from 101·2° F to normal. Spleen and liver seem to be normal. Blood smear contains the benign tertian rings.

Treatment: Quinine, grains x, twice daily; and plasmoquine, 0·01 (a.m.) and 0·02 (p.m.) gramme daily.

August 3 to afternoon of August 7.—No pyrexia, or other signs or symptoms of disease.

Evening of August 7.—Temperature has risen to 101·2° F.

Morning of August 8.—Temperature 103° F. Pulse 126. Patient is slightly jaundiced and cyanosed. Spleen and liver apparently normal. No urine voided to-day. A catheter specimen, 10 ounces, is very dark coloured. A tarry stool has been passed.

Plasmoquine-quinine stopped. The patient has now had, in all, quinine 120 grains, and plasmoquine 0·18 gramme, spread evenly over six days.

The laboratory reports as follows:—

Blood: Red cells, 2,650,000. Marked anisocytosis; numerous nucleated reds and megaloblasts present. White cells, 30,600. Polymorphonuclears 72 per cent; lymphocytes 25 per cent; large monocytes 3 per cent; hæmoglobin, about 85 per cent; colour of blood, a dingy grey.

Urine: Reaction, alkaline. Colour, dark reddish-brown. Heavy granular deposit of the same colour, amorphous phosphates and red blood cell debris in large masses. Methæmoglobin present.

Fæces: Occult blood test, positive.

1 p.m.: Temperature 102° F. Pulse 140. Mental condition, clear; general condition as before.

Urine: Characteristics as above, 4 ounces.

4 p.m.: Patient cyanosed and restless. Urine of the same description passed. Tarry stool passed.

August 9.—Temperature has varied between 103·2° and 101° F. Pulse 140. General condition still gives rise to anxiety. Anæmia is profound but cyanosis is less evident. Bilious vomiting is taking place. Dark coloured urine and tarry stool passed. Urine in twenty-four hours, 44 ounces.

1 p.m.: General condition is improving.

Blood: Red cells, 1,325,000. Large mononuclears, 11 per cent. Hæmoglobin, about 60 per cent.

From August 10 onwards, steady improvement to eventual recovery took place.

On August 20 the blood picture showed red cells, 2,225,000. Polymorphonuclears, 46 per cent; lymphocytes, 42 per cent; large mononuclears, 10 per cent; eosinophiles, 2 per cent; hæmoglobin, 75 per cent.

August 26.—Convalescence definitely established.

Here, again, we have a picture just as likely to be that of blackwater fever as of plasmoquine poisoning, except for the occurrence of slight cyanosis, and what was apparently marked methæmoglobinuria. The swift and massive destruction of red blood-cells, and the comparatively high percentage of large mononuclears will have been noticed. We may agree that this patient is to be congratulated on his recovery.

The two following cases are not so alarming: Case 7.—A Hindu cook attached to the Royal Corps of Signals.

Arrived in Quetta from leave at his home, Hoshiarpur, Punjab, in January, 1933.

Aged 24. Service, five years. Weight, 7 stone 6 pound. Physique, fair.

August 9.—Admitted with signs and symptoms of malaria, of three days' duration. Temperature 99°, 103°, 98° F. Spleen hard, and enlarged to two fingers. Blood-smear contains malignant tertian rings.

Treatment: Quinine, 20 grains, and plasmoquine, 0·03 gramme, daily.

August 10.—Temperature 97°, 101·6°, 99° F.

August 11.—Temperature normal. Patient jaundiced.

Specific treatment stopped. Total amounts given to date: quinine, 40 grains, and plasmoquine, 0·06 gramme, spread evenly over two days.

August 12.—Temperature rising. Jaundice increased. Dark coloured urine passed.

Blood: Red cells, 3,120,000. Leucocytosis. Polymorphonuclears, 72 per cent; lymphocytes, 21 per cent; monocytes, 6 per cent; eosinophiles, 1 per cent; hæmoglobin, 85 per cent.

Urine: Reaction, acid. Small amount of brown amorphous deposit. Albumin and methæmoglobin present. No bile pigment detected.

Fæces: No occult blood.

August 13.—Temperature 98° to 102·4° F. Red blood-cell count, 2,160,000. Thirty-six ounces of urine passed in twenty-four hours.

August 14.—Red cell count, 2,980,000. Large mononuclears, 8 per cent; hæmoglobin, 80 per cent.

August 18.—Patient is making an uninterrupted recovery.

August 25.—Convalescence established.

In this case the destruction of red blood-cells was moderately severe. Plasmoquine was stopped on August 11, and improvement set in three days later.

The next case was milder still. It is reported in order to complete the series.

Case 8.—A Hindu sepoy of a rifle regiment.

Aged 28. Service, one and a half years. Weight, 9 stone ½ pound. General physique, fair.

He was on leave at his home, Fatehgarh, Lucknow District, in September, 1932, when he had an attack of malaria. He has been stationed in Quetta since November, 1932.

August 2.—Admitted to hospital with signs and symptoms of malaria of one day's duration. Temperature 101°, 97°, 99·4° F. Blood smear contains benign tertian schizonts.

Treatment: Atebrin, 0·1 gramme, thrice daily.

August 10.—Temperature has remained normal since August 4.

Atebrin stopped after a total administration of 2·1 grammes.

Plasmoquine prescribed: 0·03 gramme daily.

August 11.—Slight jaundice has developed. Plasmoquine stopped: total taken, 0·06 gramme.

August 12.—Since August 10 patient has had an evening rise of temperature, 99° to 100° F.

Blood: Red cells, 3,080,000. Polymorphonuclears, 56 per cent; lymphocytes, 33 per cent; large mononuclears, 8 per cent; eosinophiles, 3 per cent; white cell count, 7,250; hæmoglobin, 80 per cent.

Urine contains a trace of what seems to be methæmoglobin.

August 14.—Red blood-cells, 2,800,000. From this date onwards the

patient made steady progress. Convalescence was established by August 25.

A board of medical officers investigated these Quetta cases on the spot, examined the documents and took the evidence of all medical and nursing personnel connected with the five patients. The results were nugatory. The Assistant Director of Hygiene and Pathology, Army Headquarters, then visited Quetta, and his report on the visit is attached to this communication [47]. Although the report throws no further light on the ætiology of the outbreak, it will be found of interest. It is curious that, if these cases suffered from over-doses of plasmoquine, not a scrap of evidence to that effect could be obtained ; and it must be remembered that, if blackwater fever is ruled out of court, plasmoquine toxicity is the obvious—the only—resort. In other words, it is the obvious that gives birth to the suspicion ; and, when there is not a particle of evidence in support, *the* intriguing question still remains unanswered : Can it be said that plasmoquine toxicity is the *only* factor in the problem? As in the case of blackwater fever—is there not a missing, a still unknown, ætiological agent concerned in this form of hæmoglobinuria?

There remains two cases to be described. Both were severe, and both ended fatally.

Case 9.—A Hindu syce attached to Frontier Force cavalry.

Aged 30. Service eight years. A small man who weighed only ninety one pounds.

July 31.—Admitted to hospital at Wana, complaining of "fever," of two days' duration. Temperature 99·2° to 103° F. Spleen enlarged two fingers. Liver apparently normal. Blood contains benign tertian rings [14].

Treatment: Quinine, grains x, and plasmoquine, 0·01 gramme, each twice daily. As the patient was a "light weight," the dose of plasmoquine was purposely kept low.

August 1 to 3.—Temperature fell during the night of July 31, and has remained normal since. Patient looks and feels well.

August 4.—This evening the temperature has risen to 100°. Pulse 102. Patient complains of abdominal pain.

Specific treatment stopped, after a total administration of quinine, grains 100, and plasmoquine, 0·09 gramme, spread evenly over a period of five days.

10 p.m.: Patient complains of severe headache.

August 5.—At 2 a.m., painful, bilious vomiting set in.

7 a.m.: Temperature 99° F. Patient's mentality is clouded. Bilious vomiting is frequent and severe. Cyanosis is distinct, and the skin, conjunctivæ and mucous membranes are deeply jaundiced. No urine has been passed since last night, but the bladder is not distended.

Blood: Red cells number only 562,500. White cells, 3,437. Polymorphonuclears, 64 per cent ; lymphocytes, 31 per cent ; mononuclears, 5 per cent. No parasites present.

10 a.m.: Patient is very drowsy. Jaundice is intense, and bilious vomiting continues to be frequent and severe. Dark coloured urine passed involuntarily.

1 p.m.: General condition grave.

Red blood-cell count is 876,500.

Eight ounces of reddish-black urine passed. Reaction, acid; albumin ++; large number of casts, hyaline and tubular; very few red blood-cells. Hæmoglobin present; but whether oxy- or met- was not noted.

6 p.m.; Temperature 101° F. Pulse 130. Patient unconscious. Jaundice intense. About 6 ounces of urine were passed at 5 p.m., and again at 6 p.m.

8 p.m.: General condition worse. Four ounces of dark urine passed.

August 6.—Patient died at 2.45 a.m.

A post-mortem examination did nothing to clarify the diagnosis. Nothing of significance was found in the heart or suprarenals. The spleen was enlarged, unduly hard, and contained malaria pigment. In the liver there was slight parenchymatous degeneration, and the cells contained malaria pigment. Parenchymatous degeneration was present in the kidneys: the tubules contained albuminous matter; hæmoglobin-stained casts were present, and there was a small amount of melanin pigment. In fact, the same post-mortem findings as one would expect in blackwater fever [48]. In what respects these differ from the post-mortem appearances in a human case of death from plasmoquine poisoning we cannot definitely say, because—according to the experts—patients do not die, provided the plasmoquine is cut off in time.

Nevertheless, in this instance, prompt stoppage of the small dose of plasmoquine which was being administered had no beneficial effect whatsoever.

Note the rapidity and degree of blood-destruction; the abdominal pain, intense jaundice, constant bilious vomiting and cyanosis; the decreased urinary excretion, hæmoglobinuria and stupor passing into coma.

The officer commanding the hospital in which this patient died was a skilled physician who had had experience of blackwater fever. In a detailed commentary on the case, he was inclined to make a diagnosis of plasmoquine toxicity; but it cannot be said that there is any more confidence or finality about this case than about several of the others.

Case 10.—A Sikh gunner from the Punjab. Aged 21. Service, three and a half years.

August 8.—Admitted to hospital, Kohat, complaining of "fever" of one day's duration. Temperature on August 7, 101·5° F., now normal. Patient looks ill. Spleen and liver apparently normal.

Blood smears contain malignant tertian rings.

Treatment: Quinine, grains x, twice daily.

August 9.—Rigor: temperature 102·4° F. Temperature fell this evening.

August 10.—Temperature 98·8° to 99·5° F. Quinine to be continued. In addition, plasmoquine, 0·03 gramme daily, prescribed.

August 13.—Since August 10, temperature has varied between 99° and 98·2° F. This morning it rose to 102° F.

Slight icteric tinge of skin and conjunctivæ is noticeable, and bilious vomiting has set in. Examination of the urine reveals nothing abnormal.

Plasmoquine discontinued, the patient having had a total of 0·10 gramme, spread evenly over three and a half days.

August 14.—Temperature has remained up in the neighbourhood of 103·5° F. Jaundice is intense, and bilious vomiting distressing.

Blood: Red cells, 2,630,000; white cells, 26,250.

Urine, port wine coloured. Reaction, slightly acid. Albumin +; urates + +; bile pigment −. Hæmoglobinuria very marked.

Quinine discontinued. Total amount taken over a period of five and a half days, grains 110.

6.30 p.m.: Patient unconscious. Urine is passed involuntarily, at fairly frequent intervals, and in amounts which are estimated to be about 10 ounces. It is markedly hæmoglobinuric (port wine) in character.

8 p.m.: Gravity of the general condition remains unaltered. Dark brown stool passed.

11 p.m.: Patient died.

In this case, also, a post-mortem examination was carried out. The findings were similar to those in the preceding Case 9; but in Case 10 the pathologist stresses the following points:—

Intense icteric staining of the subcutaneous fat; high degree of anæmia and friability of the internal organs; and treble enlargement, engorgement and friability of the spleen.

The reader will be struck by the differences between these two cases (9 and 10) and those of the Quetta series. In the former we find no mention of marked cyanosis; and we read of port wine hæmoglobinuria. This colour could hardly be confused with black-brown—like stout—or dingy grey. In fact, patients 1, 2, 3, 9 and 10 bear to each other a strong family likeness. So do patients 4 to 8. But, if the two families are closely akin, it cannot be admitted that they are one and the same.

Conclusion.

The Indian school of thought may well exclaim: "Very good; but show us, from the area in question, a blackwater fever patient to whom—with absolute certitude—no plasmoquine has been administered."

To that, the reply may be: "Perhaps blackwater fever is an entity. May be plasmoquine toxicity is an entity. But that is not the whole story; and the sooner plasmoquine is connected up with blackwater fever in much the same way as quinine now is, the better."

I am indebted to Major-General Sir John Megaw, K.C.I.E., I.M.S., to

Major-General J. D. Graham, C.B., C.I.E., I.M.S., and in particular to Lieutenant-Colonel J. A. Sinton, V.C., C.B.E., I.M.S., for much valuable assistance and criticism. I would also gratefully acknowledge the help given by Major J. S. K. Boyd, R.A.M.C., and, as regards the Quetta cases, by Major D. T. M. Large, R.A.M.C.

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[45] See [38], vol. xvii, pp. 805 and 806.

[46] See [39], vol. xvi, p. 169, and vol. xvii, p. 804.

[47] INVESTIGATIONS REGARDING THE CASES OF ? PLASMOQUINE POISONING AT QUETTA.

This question was discussed with all the members of the Court of Enquiry, and with various others who had been interested in or concerned with the cases.

The first point to determine is the correct diagnosis of these cases.

The blood condition, as well as the other symptoms, was critically discussed with Major Large. Although he had not a spectroscope by the use of which a definite conclusion could have been reached, there is no reasonable doubt that massive methæmoglobinæmia was present. This contra-indicates blackwater fever (in which the condition is normally one of oxyhæmoglobinæmia) and in fact practically every known condition except poisoning with certain drugs. The only drug of this type which these patients received was plasmoquine, whose action in producing methæmoglobinæmia when given in overdoses is well known.

It appears therefore certain that these were cases of plasmoquine poisoning.

The following proposition was taken as a basis for discussion, viz.: Normal plasmoquine administered in the authorized doses to normal individuals will not give rise to toxic symptoms. Our results over two years make this statement one of fact—there is ample practical experience to substantiate it. This proposition was agreed to by everyone with whom the matter was discussed.

Arising from this the following points are to be discussed in relation to these cases:—

(1) Was the plasmoquine unduly toxic?

In discussion with Lieutenant-Colonel Sinton in Kasauli on September 10, 1933, it was pointed out that, in the early days of the experiments at the Malaria Treatment Centre, on one occasion there was a sample of plasmoquine which was definitely more toxic than normal. This belonged to a newly-received consignment and was spotted more or less at once, as the toxic symptoms occurred as soon as the new sample was taken into use. The history of the present sample is as follows:—

10,000 tablets each of 0·02 gramme and 0·01 gramme of plasmoquine were received on one indent on January 17, 1933. The consignment was in five bottles of 2,000 tablets of each size.

Two bottles were used without any untoward effect. The first of the cases in the above series was treated from the last two tablets of the third pair of bottles. The remaining four were from the fourth bottles, which were then withdrawn. The fifth bottles were taken into use and have since been finished. The fourth bottles are now again in use without any untoward effects.

There is now only about one-fourth of a bottle left. Total used to date of this consignment is 9,500 tablets. At 21 tablets per case this equals 452 cases. Actually many more than these have been treated, as large numbers of cases have been treated with atebrin and plasmoquine, where only 5 tablets of each are used.

Taking into consideration the fact that many patients were treated with this batch before any toxic cases occurred, and again that many have been treated subsequent to the occurrence of the cases, and as all five cases occurred within nine days, it can safely be said that the balance of evidence is strongly against the suggestion that this is a toxic batch of plasmoquine. Further evidence of its toxicity would definitely have cropped up in other cases. Under the circumstances the occurrence of a batch of five cases in nine days caused by toxicity of the sample is outside the bounds of reasonable possibility.

A further suggestion has been made that these bottles of tablets may have been made up from different "brews," and that certain tablets may have had toxic properties while the majority had not. This is of course possible, but in the ordinary course of events unlikely. Unless there were present a very few highly toxic tablets, it is difficult to understand why only five men out of the many who were under treatment should have been affected in this way. Also similar cases would have occurred in other parts of the country where the remainder of the toxic brew was used.

(2) Were the patients unduly susceptible?

(*a*) Idiosyncrasy is of course a possibility, but this can be excluded for the same reason as is given above. A group of 5 cases all with an idiosyncrasy is not likely—in fact highly improbable.

(*b*) Were the men of unduly poor physique? Inquiries elicit that the first case—Cooly Habib—was definitely a weakly, small man. The others were average.

There is therefore nothing to suggest that the occurrence can be explained by the physical condition of the patient.

(3) Is there any possibility of any other drug having enhanced the toxicity of plasmoquine?

No other drugs except quinine or atebrin were given to these cases.

Quinine is supposed to reduce the toxic action of plasmoquine. According to some the use of atebrin may enhance the toxicity. Taking these five cases plus the one case from Kohat, both these contentions seem to be disproved.

Three had atebrin. Two died and one was a mild case.

Three had quinine. One died, one was a severe and almost fatal case, and one was moderately mild.

Honours are therefore easy. The evidence in these cases that atebrin was responsible for the mischief because of its conjoint action with plasmoquine is nil.

(4) Was an overdose of plasmoquine given?

According to the evidence brought forward in the Court of Enquiry, no overdose was given.

The inquiry therefore reaches a blank wall. As far as possible everything has been investigated and no answer to the conundrum has been found.

It remains to reconsider the above points and determine if in any of them the evidence is weak.

Of the four points only one rests on verbal evidence only. This is number (4)—the question of overdose.

This was discussed in every detail with the President and members of the Court of Enquiry. There was no evidence whatsoever to suggest that an overdose had been given. The personnel looking after these cases had all been doing this same work for some time previously. Those responsible for issuing treatment were quite familiar with the different appearance of tablets of atebrin and plasmoquine.

In spite of this evidence, the impression remained in the minds of those who inquired into the cases at the time of their occurrence that in some unexplained way an overdose, or a series of small overdoses, may conceivably have been taken by the patients.

To summarise, there is no evidence from which a definite conclusion can be reached regarding these cases. There is a vague possibility that an overdose may have been given despite evidence to the contrary. The overdose at the worst cannot have been a massive one.

It seems possible that the margin of safety for Indian troops is less than it should be, and, in consequence, the policy of lowering the dose by 50 per cent for Indian troops seems wise, especially in view of recent work which suggests that smaller doses are equally satisfactory.

There is no tangible evidence to incriminate atebrin as a contributory factor.

Of the British troops treated, no cases have shown any toxic symptoms whatever, either from quinine plus plasmoquine or atebrin plus plasmoquine.

[48] See [5], pp. 180 to 183, and [33], pp. 90 to 92.

THE RADIOLOGICAL INVESTIGATION OF THE ACCESSORY NASAL SINUSES BY THE "UPRIGHT" METHOD.

By Major H. E. YORKE, M.C.,

Royal Army Medical Corps.

It has been pointed out by Dr. Graham Hodgson that the value of radiology as a diagnostic aid in diseases of the accessory nasal sinuses has in the past not been appreciated to anything like its proper extent.

That this has been the case cannot very well be denied, the fault being due largely to the adoption of a technique in skull radiography, that has become standardized, but which fails to give the best possible results.

The object of these notes, therefore, is to suggest a method of carrying out the Graham Hodgson technique in Army X-ray departments by means of an easily made and inexpensive piece of apparatus.

It has always been the aim in radiological work to produce films taken in standard positions in order to obtain comparative results, and hence the so-called "nose-chin" and "nose-forehead" positions were adopted with the patient lying prone. These are not in fact "standard" positions at all, as the widely varying facial contours of the patients are not taken into account. In addition, the fact that the nasal sinuses are air-containing cavities was lost sight of. Pathological conditions, such as hyperplasia of the mucosa or the presence of fluid or pus, could not be differentiated.

With the patient in the prone position the presence of fluid often escaped detection as it spread out over the anterior aspect of the cavity in a thin layer which was invisible on a radiograph. The best that could be done in these circumstances was to report that a sinus was "opaque" or "dim," the reason for this condition being left to the medical officer in charge of the case to ascertain for himself.

The interpretation of radiographs taken by this method was rendered difficult, not only by the lack of standardization of position, but also by the fact that in dealing with the accessory nasal sinuses the superposition of a multiplicity of bony structures varying in density and in distance from the film caused a confused picture.

By placing the patient in the erect position and by the adoption of a system of radiography that ensures the taking of films in standardized positions, many of these difficulties can be overcome, and fluid if present can be demonstrated as a fluid level, an undoubted advance on the old method.

The chief obstacle in attempting to carry out this work in X-ray departments has been the cost of the stand necessary, which is considerable.

Fig. 1 illustrates the device employed in the Q.A. Military Hospital, viz., a strong frame made of 4 by 2-inch wood with a firm base to ensure complete rigidity. It is essential to have a head-rest and it is desirable to use a Potter-Bucky diaphragm, the frame being so made that the head-rest and diaphragm are readily detachable.

Cassette holders of three-ply wood to fit into the Bucky tray and an adjustable operating theatre stool or music stool complete the necessary equipment.

The wooden frame depicted and five cassette holders of various sizes, were made for the total sum of four pounds by the hospital carpenter. I

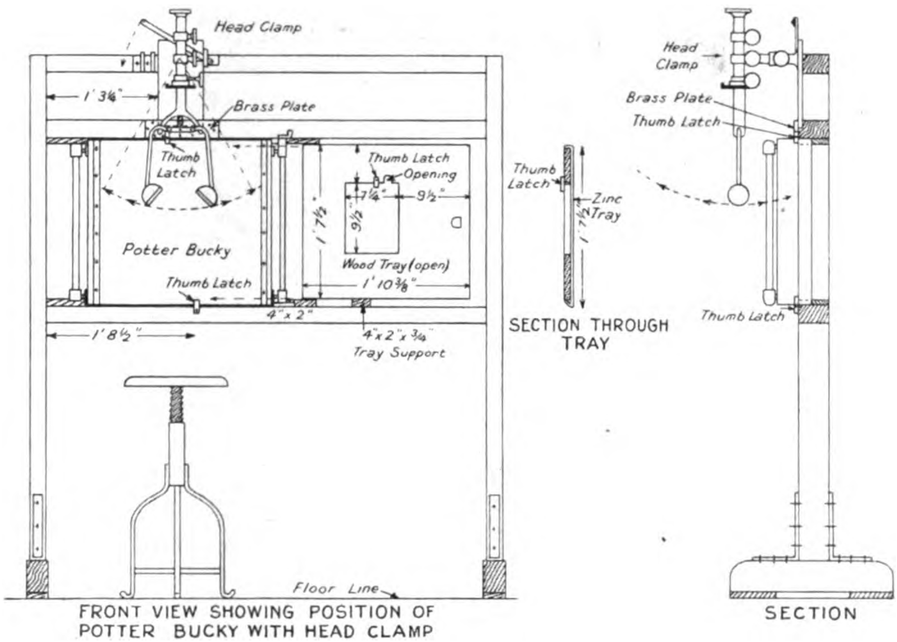

Fig. 1.—View of wooden stand showing incorporation of head clamp and Potter-Bucky diaphragm.

have no hesitation in saying that this money has been well spent and that the cost has been repaid in the value of more accurate diagnosis.

The value of the stand is not restricted to radiography of the nasal sinuses, for by using variously sized films valuable results can be obtained in such matters as the effect of weight bearing on joints, and the use of Uroselectan B in diverticula of the bladder, etc. Excellent lateral views of the spine and sternum can be obtained and also enlarged lateral views of the skull. Stereoscopic views can be obtained when necessary.

The technique is based entirely on that of Dr. Graham Hodgson.

The patient is seated on the operating stool and, with the exception of the position necessary for the view of the sphenoidal sinuses, faces the Potter-Bucky.

The Potter-Bucky diaphragm should be lightly engraved with a cross-marking to ensure correct centring.

The surface markings of the patient used to ensure correct angulation of the head to the film are the outer canthus of the eye and the external auditory meatus, called, for ease of reference, the "orbito-meatal" line.

The vertical movement of the patient is regulated by means of the adjustable stool.

FIG. 2.—View of frontal sinuses, taken with patient in the "chin-nose" position, showing no abnormality.

POSITION 1.

Patient faces the Potter-Bucky diaphragm, head clamped in the bi-temporal position, orbito-meatal line perpendicular to the film. Tube centred just below the external occipital protuberance.

View obtained: Anterior ethmoid cells superimposed on the posterior ethmoid cells and the sphenoidal sinuses. A view is also obtained of the

maxillary antra, but not a good one. It will be noted that the shadow of the petrous bones is seen well above the antra.

Position 2.

Patient faces the Potter-Bucky diaphragm, head clamped as in Position 1, orbito-meatal line at an angle of 45° to the film, with the face tilted upwards.

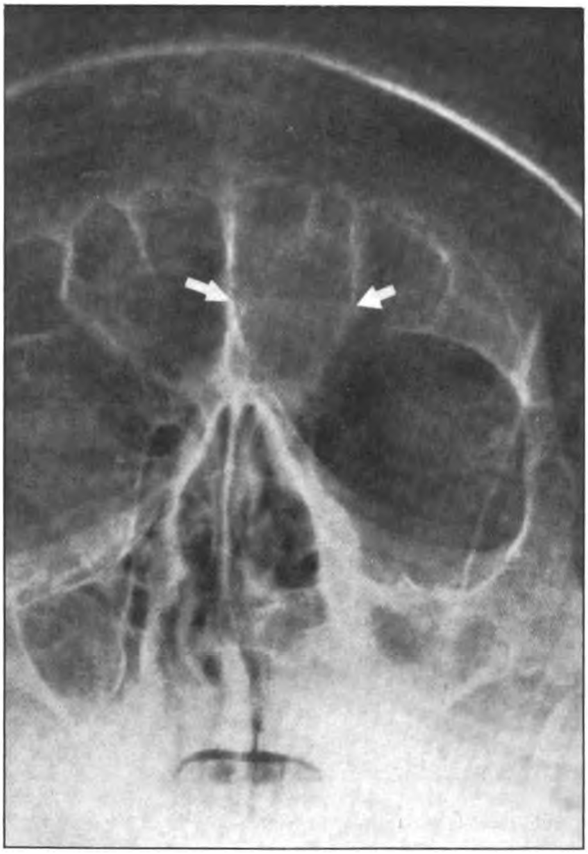

Fig. 3.—View of frontal sinuses of same patient taken in the "upright" position showing fluid level in the left frontal sinus.

Tube centred over the external occipital protuberance.

Views obtained: Frontal sinuses, maxillary antra, anterior ethmoid cells. Shadow of petrous bones seen below the antra.

Position 3.

Should fluid be detected or suspected in either the frontal sinuses or the maxillary antra, a confirmatory view can be obtained by clamping the head as in Position 2, having first given the head a lateral tilt.

Fluid if present will conform to the new position and show a horizontal level accordingly.

In practice it is found to be more satisfactory if the side suspected is placed on the higher level, when it will be found that the altered position of the fluid level is more readily demonstrated.

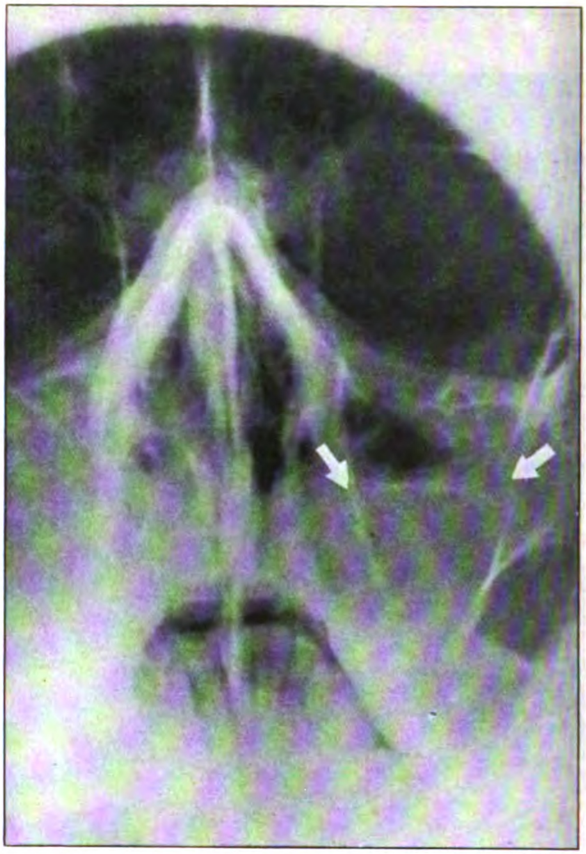

FIG. 4.—Fluid level left maxillary antrum taken in the "upright" position.

POSITION 4.

Patient seated with back to Potter-Bucky, head extended back as far as possible with the plane of the face roughly at right angles to the film, and held in position with the head clamp.

Tube centred just below the chin.

View obtained: Sphenoidal sinuses.

POSITION 5.

Patient seated facing Potter-Bucky, head extended slightly with the orbito-meatal line at an angle of 35° to the film, then head rotated to either right or left 39° (read off scale on head clamp).

Tube centred just behind mastoid process.

View obtained: Posterior ethmoids, projected on radiograph in and below orbit. In this view also the optic foramen is well seen.

POSITION 6.

Standard lateral view of skull to show this aspect of the nasal sinuses.

Space forbids the illustration of all the results so far obtained, which

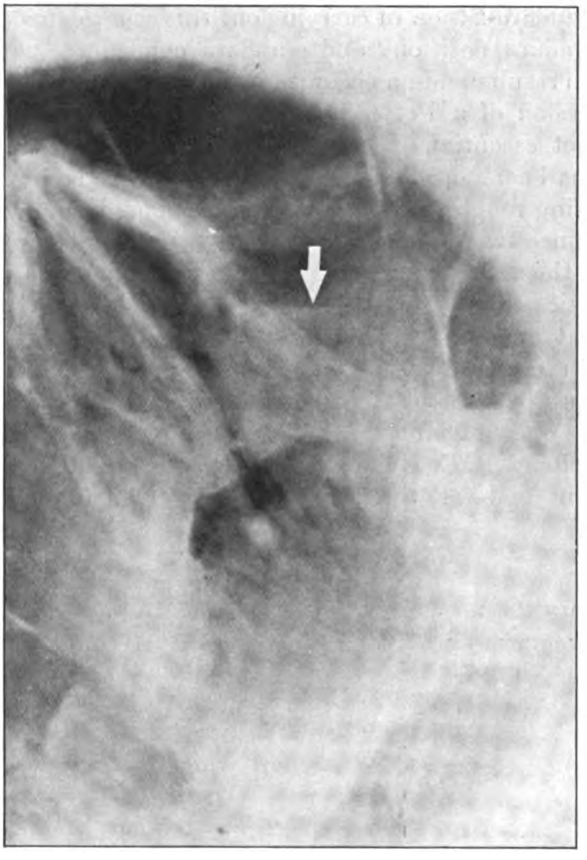

FIG. 5.—View of same case, taken in the "upright" position with head tilted laterally, showing fluid level conforming to new position of head.

have been interesting and instructive. In those that have been investigated the results are encouraging. In this connection an interesting feature is that transillumination is found not to be a certain method of diagnosis, the radiological findings frequently showing abnormalities not indicated by that method.

Fig. 2 represents a view taken in the "chin-nose" position, from which a definite diagnosis of any pathological condition would be difficult to make.

Fig. 3 is a view of the same case taken in the upright position in which a clearly seen fluid level in the left frontal sinus is apparent.

Fig. 4 is a reproduction of a radiograph in which the left maxillary antrum can be seen to be half filled with fluid.

The alteration of the fluid level on tilting the head is seen in fig. 5.

Other pathological conditions which can be shown by the Graham Hodgson technique are antral polypi, new growth involving the walls of the nasal sinuses, hyperplasia of the mucosa, etc. The importance of the adoption of standardization in carrying out this work cannot be too greatly stressed. Standard positions and standard conditions being essential to obtain uniform results and an accurate standard of comparative radiographs.

The possession of a Potter-Bucky diaphragm, though in my opinion desirable, is not essential, excellent radiographs being obtainable without its use. A small cone on the X-ray tube is advisable and good results can be obtained using roughly the following conditions, K.V. 70 to 80, M.A. 30. Tube film distance twenty-eight inches. Exposure time four to five seconds, varying with the thickness of the part to be radiographed.

With practice this method is readily and quickly carried out and it is considered that much useful research remains to be undertaken by means of "upright" radiography.

My thanks are due to Major-General J. W. West, C.M.G., C.B.E., K.H.S., for his encouragement and advice in preparing these notes, and to Lieutenant-Colonel R. C. Hallowes, D.S.O., for permission to send them for publication and for the financial aid given for constructing the apparatus.

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SPINAL TUMOURS, THEIR DIAGNOSIS AND LOCALIZATION.

By Major A. G. BIGGAM, O.B.E.,
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Recently great advances have been made in the methods of localization and surgical treatment of tumours of the brain; it is now possible to remove even large new growths with complete success, the operative mortality in the most skilled hands being at the present time under 10 per cent. Equal if not greater progress has taken place in the methods of dealing with spinal tumours and a consideration of this problem should be of special interest as tumours in this situation are by no means uncommon, and when diagnosed the operative results are often most satisfactory. That these tumours are not rare will be seen from Schlesenger's report on a series of 35,000 post-mortems where spinal cord tumours were found in 43 (i.e. about 2·06 per cent of the total number of tumours).

As regards the level incidence, Potal and Væudeau found that 52 per cent of the spinal cord tumours were in the dorsal region, 20 per cent cervical, and 28 per cent lumbosacral and caudal.

With regard to their relation to the circumference of the cord, Frazier found about 75 per cent to lie on the dorsal or dorsolateral aspect of the cord; in Elsberg's series 64 per cent were posterior and the rest were ventral or ventro-lateral.

The term tumour is generally used in a clinical sense to include new growths, gummata, cysts, tuberculous abscesses, etc., but in Elsberg's and Antoni's series the term is limited to new growths. In about 400 cases collected by Schlesenger the nature of the tumours was as follows:—

Sarcoma and glioma, 134; tuberculous, 64; hydatid, 44; neurofibromata, 37; gummata, 28; endotheliomata, 24; and other rare conditions.

Elsberg found that 20 per cent of his series were neurofibromata and fibromata, and 48 per cent endotheliomata. Antoni, after a careful study of 30 cases of spinal cord tumours, found that two-thirds were neurofibromata and one-third endotheliomata. It may be concluded from this that neurofibromata and fibromata form a large proportion of spinal cord tumours and as they are benign and easily removable the chances of recovery after surgical treatment are very great.

Cord Changes.

It has been shown by Riddoch and Purves Stewart that the effect of the actual pressure on the cord elements is very limited, degeneration, softening and atrophy usually only occurring in the immediate vicinity of the tumour; more serious damage and interference with cord function may, however, be produced by interruption of its blood supply by œdema, hæmorrhage, or thrombosis.

Elsberg considers that the majority of cases of spinal tumour with

symptoms of less than two years duration will recover after removal of the growth and be able to return to work. One should therefore not despair of obtaining good results even though paralysis be extensive and of long duration.

Classification.

The topographical and not the histological features are taken as a basis for classification. Tumours are thus divided into:—

(1) Extradural, arising in the arches or bodies of vertebræ or extradural fat. These form about three-sixteenths of the total and the majority of them are of a malignant nature.

(2) Intradural, but extramedullary. Fifteen of twenty-seven cases collected by Sargent belonged to this group. In Elsberg's series of 100 cases three-fourths were extramedullary; of these 78 per cent, or more than half the total, were intradural. Most of these tumours are benign and easily removable; in many cases they lie almost free in the subdural space and can be very easily shelled out.

(3) Intramedullary. They usually form from one-sixth to one-fourth of all the cases.

Clinical Features.

In the majority of cases, the onset of symptoms is slowly progressive. From the clinical standpoint the whole course of the disease can be divided into two stages. (1) Irritative stage or stage of root symptoms, which are generally of a neuralgic nature. (2) Stage in which symptoms due to interference with cord function appear; these vary from impure Brown-Séquard's paralysis to complete compression paraplegia.

(1) *Irritative Stage with Root Symptoms.*

(*a*) Pain is usually the first symptom occurring in about one-third of the cases of extradural tumours, in two-thirds of intradural extramedullary and in less than one-sixth of intramedullary growths. In a series of 100 cases collected by Elsberg only 27 had no pain at the onset and in only 8 was pain absent throughout the whole course of the disease. It was the first symptom in 8 out of 15 cases described by Sargent. In our series it was practically absent in one case and present to a varying degree in the rest. These pains are usually referred to the area of distribution of one or more roots and may be accompanied at first by hyperæsthesia in this area and later on by anæsthesia (anæsthesia dolorosa).

As regards severity, this varies from a mere unpleasant sensation of constriction to the most severe and persistent pain. Starr considers that there is no other disease which causes such recurring and persistent pain. The pain is in many cases aggravated by movements of the spine or by strong expiratory efforts, such as coughing, sneezing, straining, etc.

It may appear suddenly and persist throughout the whole course of the illness: but in many cases it disappears when symptoms of cord compression become prominent.

Root pains vary in nature according to the segmental level of the tumour and may simulate any visceral disease, hence the importance of recognizing this possibility in all cases of vague and persistent pains. Pain due to involvement of the upper thoracic nerve roots is often referred to the axilla, underneath the scapula or to an intercostal space. It is here that a diagnosis of pleurodynia, pleurisy, angina pectoris, intercostal neuralgia, etc., is often made and the case is thus wrongly treated for long periods.

Tumours situated in the lower dorsal region may give rise to pain simulating intra-abdominal disease such as intestinal, renal or biliary colic, flatulence, gastric ulcer, etc.

Tumours of the cauda equina give rise to intense pain which may radiate down the backs of the legs, and it may be sometimes difficult to differentiate these cases from ordinary sciatica.

In addition to the above root pains many cases of cervical and upper dorsal tumours start with pain in both lower limbs due presumably to pressure on the pain fibres in the spinal cord.

(*b*) Motor irritative phenomena may occur early if the tumour involves anterior nerve roots. Tremors and spasms are quite common in these cases and fibrillary twitchings may be seen even when marked atrophy of the corresponding muscles is present. These are more frequent in intramedullary tumours.

(2) *Stage with Cord Symptoms.*

As soon as the tumour begins to exert pressure on the cord two sets of symptoms appear.

(*a*) Local symptoms due to compression and destruction of the segment subjected to the direct pressure of the tumour and consisting of atrophy and paralysis of the muscles supplied by this segment with resultant reaction of degeneration and absence of deep reflexes. These signs must be looked for carefully, usually in the area of previous root pains, because they denote the segmental level of the tumour.

(*b*) Remote symptoms due to pressure on the long tracts traversing the cord. No rule can be formulated regarding the progress of symptoms of this class, as they vary a good deal according to whether the tumour is extra- or intra-medullary, also as regards its position in relation to the circumference of the cord, and whether it is slowly growing or not. In all, however, the paralysis, although increasing in cross-section intensity, does not show any marked tendency to progress upwards or does so only to a slight degree.

Tumours lying to one side of the cord give rise at first to spinal hemiparesis and later to paraplegia. Reversed Brown-Séquard's Syndrome has been described by Elsberg, especially in extradural tumours.

In cervical tumours the order of the progress is almost always as follows :—

Affection of the upper limb of the corresponding side; then the homolateral lower limb, followed by the opposite lower limb, and lastly, the

contralateral upper limb. In benign extramedullary tumours the weakness is slowly progressive, starting in one lower limb and progressing upwards from toes, feet, etc., then involving the opposite side in the same order.

Signs of pyramidal lesion in the form of extensor plantar response, absence of abdominal reflexes, etc., may appear early; the chief reflexes, however, may remain normal for a longer time after paralysis has developed than in many other spinal diseases (Williamson).

With more extensive lesion of the pyramidal tracts the flexor withdrawal response appears; its receptive field increases, so that it can be elicited by any strong stimulus applied to the body below the level of the lesions. Mass reflexes may also be present.

At first, when the pyramidal tracts are alone involved, rigidity is more marked in the extensor muscles and paraplegia in extension results; later on other extrapyramidal tracts are affected and paraplegia in flexion results; flexor spasms occur which may be painful, and later still the limbs are held rigid in flexion.

Paraplegia in flexion is therefore a late phenomenon, and when present denotes a severe compression destroying the extrapyramidal as well as the pyramidal fibres, and is an indication for immediate surgical interference. It is characterized by flexion of the different segments of the lower limb upon each other, weak or absent knee-jerk and marked exaggeration of the flexor reflexes.

Objective sensory changes usually appear late and so are of little localizing value in the early stages of the disease.

Similarily sphincter troubles do not usually appear until motor and sensory phenomena are well marked, though they may be early in onset in intramedullary tumours of the lumbosacral region where the bladder and bowel reflex centres are directly affected. Bladder disturbances are usually the first to appear; precipitate micturition, and some hesitation in the act or actual retention may be present. Constipation, tympanitis or incontinence of fæces are usually late phenomena.

Bed sores appear early in tumours of the lumbosacral region and cauda equina.

Varying Clinical Picture at Different Levels.

The root pains and other neurological findings vary according to the segmental level of the tumour. The following additional signs may be present.

In the upper cervical region nystagmus is sometimes present. Intense pains and stiffness of the neck resembling very much cervical caries; spasmodic torticollis or muscular rheumatism are frequently seen, especially in extradural tumours of a malignant nature involving the vertebræ.

If the roots of the phrenic nerve on one or both sides are affected partial or complete paralysis of the diaphragm may occur.

Tumours of the lower cervical and upper dorsal region, in addition to

producing atrophy and weakness in the small muscles of the hands, may involve the cervical sympathetic, causing in the early irritative stage exophthalmos, dilatation of pupils and retraction of the upper lids with vasomotor and secretory changes in the face, neck and upper limbs.

Neurological Data from which the Level of Growth can be Determined.

The chief cause of failure to diagnose a spinal tumour is failure to suspect the presence of such a condition.

A most careful and painstaking neurological examination is sufficient in the majority of cases for the diagnosis and correct localization of spinal cord tumours. Dandy says that ninety per cent of cases can be accurately diagnosed in this way. The important data may be summarized as follows :—

(1) Sensory features: (*a*) Referable to roots in the form of pains and anæsthesia. They indicate with a fair degree of accuracy the segmental level of the tumour. (*b*) Referable to conducting paths; when the level of the tumour is judged from the sensory signs alone, it is often found to lie several segments higher than that indicated by the signs. This is due to the fact that the various sensory fibres follow an oblique course in the spinal cord when they cross to the opposite side to join the spinothalamic tracts. Pain crosses soonest, then cold and heat. Touch follows the most oblique course. The crossing is quick in the lumbar region, but it takes place slowly when the cord is followed upwards. In the mid-dorsal region the crossing of pain and heat is complete one segment above the point of entrance of the corresponding nerve-root, whilst in the cervical region this decussation may take five or six segments before all the fibres reach the opposite side. It follows from this that the level of sensory loss is highest for pain and lowest for touch.

(2) Motor paralysis : (*a*) upper motor neuron type of affection indicating that the tumour causing it is at a higher level; (*b*) lower motor neuron type showing the segment affected.

(3) Reflexes: (*a*) somatic, both deep and superficial. If a deep reflex is absent and those above it are normal, while those below are exaggerated, the segmental level of the tumour is indicated; (*b*) organic.

(4) Surface anatomy of the segments: It must be noted that a given segment of the cord is situated more cranially than the corresponding vertebra. The rules given by the Committee of the Medical Research Council on injuries of the nervous system may be quoted in full :—

"(1) The intraspinal course increases fairly regularly for the cervical and thoracic nerves. It is equal to the depth of 1 vertebra for the upper cervical, 2 vertebræ for the lower cervical, 3 for the upper dorsal and 4 for the lower dorsal.

(2) The origin of the lumbar nerves is opposite the tenth and eleventh thoracic spines.

(3) The origin of the sacral nerves is opposite the twelfth spine and the ligament between it and first lumbar.

In applying these rules it must be remembered that the spinous processes vary much in length and obliquity, so that in the thoracic region, the tip of one spine may reach the level of the body of the vertebra next but one below it. Moreover the relations of the nerves to vertebræ change at the eighth cervical; above this level the nerve arises above the vertebra of the same name; below this level the nerve issues below the vertebra of the same name."

Aids to Diagnosis and Level Localization.

These should only be resorted to after a very careful clinical examination has been carried out.

They will be discussed under the following headings:—

(1) Loculation syndrome.

(2) Hydrostatic method. Queckenstedt's sign.

(3) Radiological examination both simple and aided by lipiodol.

(1) *The loculation syndrome* in the cerebrospinal fluid was described by Froin in 1903. It was the first step in the diagnosis of spinal compression. The syndrome is characterized by: (*a*) an increase in the protein content, which rises from the normal 0·025 per cent to 0·1 per cent or more. Greenfield and Carmichel propose that the term should be applied to cases in which the amount of protein is 0·5 per cent or more. An increase in the protein is not pathognomonic of compression; it is present also in syphilitic meningitis, polyneuritis and Landry's paralysis. (*b*) The number of cells remains normal or is slightly increased. (*c*) Xanthochromia or yellow colour due probably to altered blood; it is not a common feature, being present in only 39 per cent of seventy-seven cases described by Elsberg. The idea that it is due to exudation from the surface of the tumour does not hold good, as it is present in some extradural tumours. (*d*) Spontaneous coagulation due to the presence of fibrinogen. The syndrome is in all probability due to the state of engorgement of the spinal veins leading to increased permeability; the spinal fluid tends gradually to approximate in chemical composition to the blood plasma. Ayer and Greenfield lay much stress upon the protein increase as a sign of greater value than the others.

(2) *Hydrostatic Method.*—The next step in the diagnosis and localization of spinal block was by double spinal puncture; the fluid from the upper puncture differs in pressure and other respects from the lower fluid. This method was discovered in 1913 by Pierre Marie and others. Of more value than this is Queckenstedt's sign. This was described in 1916; it is simple and gives much information. By using lumbar puncture alone Queckenstedt showed that the pressure in the lumbar canal rose on compression of the jugular veins and quickly fell to normal when the pressure was removed; in cases of complete block no rise occurred. Stookey studied the results in cases of incomplete block, and found that slight hesitation or slowing in

the rise or fall of the fluid was of great significance in demonstrating block. Most of our cases gave similar results to these.

Queckenstedt's sign is not always trustworthy ; moreover, it is of no help in the localization of a tumour. It was negative in 14 per cent of Elsberg's series.

(3) *X-ray Examination.*—Whenever there are found in the X-ray plate changes in the vertebræ not due to spondylitis deformans, the most probable cause is malignant disease or a tuberculous process.

Intramedullary tumours rarely produce any change. In 13 intramedullary tumours verified by Elsberg, no X-ray evidence of any bony change was present; in 71 of intradural, 56 showed no changes, and 10 showed the changes of spondylitis deformans; in 15 cases of extradural tumours there was definite erosion from pressure in 2. In the differential diagnosis between Pott's disease and metastatic deposits in the vertebræ, Sicard and others draw attention to the fact that the latter condition primarily involves the bone and is entirely limited to it, the intervertebral discs remaining free. There results thinning of the vertebra until it becomes about one-fifth of its height, and, moreover, the change is more marked on the sides than the front.

X-ray Examination with Lipiodal Injections.

This method is very effective in demonstrating the level of a spinal block; the density of the shadows given is very striking and its use makes the diagnosis and localization almost certain. We have had considerable experience with this method and have found it of great value for accurate localization.

Lipiodol is a forty per cent solution of iodine in poppyseed oil; it was discovered by Lafay in 1920 and used by him in the treatment of lethargic encephalitis. It is transparent and pale-yellow in colour; the iodine is present in chemical combination and dissociates very slowly, being present in the urine in very small amounts over long periods. The German product iodopin is practically the same.

In 1921 Sicard and Forestier first made use of its radiopaque properties in demonstrating the level of spinal block. In 1924 lipiodol ascendans was discovered. It is of lower molecular weight than ordinary lipiodol and is lighter than the cerebrospinal fluid, and therefore it ascends in the spinal canal when injected. Owing to its diminished iodine content, the shadows given by it are not very sharp, and, moreover, it is liable to stick to the meninges in its ascent, causing confusion in the reading of results.

Early in 1927 we started using ordinary lipiodol in the medical unit as a means of diagnosing some obscure lung conditions and the details of the process were published in this Journal in July, 1929. Since then the method has been extensively employed and forms a part of the routine examination of many lung diseases in this hospital in Egypt.

About the same time we commenced using lipiodol to assist in the

diagnosis of spinal conditions, and since then many cases have been investigated, the information obtained proving of the greatest value both in confirming the diagnosis and in assisting in localizing the tumours.

Technique.

The patient is given an injection of ¼ grain morphine or pantapone one hour before injection of lipiodol; he is allowed to sit on a chair with the head flexed so as to open the space between the occiput and atlas. The back of the neck is shaved and painted with tincture of iodine. The point through which the puncture is made is in the middle line or a little to one side of it, and on a line joining the tips of the mastoid processes. The skin in this area is anæsthetized with two per cent novocain using as little as possible; too much novocain may cause swelling of the tissues and difficulty in estimating the depth of the cisternal space.

An ordinary stovain needle is used; for the beginner it is better to use one with a mark at five centimetres. The needle is steadily and carefully pushed through the skin and deep structures in a line parallel to that joining the external auditory meatus and glabella. It is always safer to direct the point of the needle a little more upwards so as to strike against the occipital bone, following this downwards one can quite easily recognize the posterior border of the foramen magnum. The needle is then pushed through the atlanto-occipital membrane and dura, and the stilette is removed. In the majority of cases no cerebrospinal fluid appears and one has to put on a syringe and apply some suction. If no fluid comes out the needle is pushed carefully inwards with the syringe in place so as to apply suction after each slight push.

The depth at which the cistern is reached varies with different subjects according to the thickness of the neck, and no rule can be formulated; but for a beginner it is advisable not to go beyond the five centimetre mark.

When the cisterna is reached 1½ cubic centimetres of the warmed clear oil are injected slowly, and after finishing the piston is withdrawn a little to make sure that the point of the needle was in the right place during the whole injection. After five minutes the patient is then X-rayed in the sitting position and again next morning.

If the above technique is carefully followed there should be no difficulty. The procedure is very simple and does not require more than ordinary skill to perform it. No cerebrospinal fluid should have been removed from the patient for several hours before the injection as the collapsed membranes take some time to refill and separate; only a few drops should be allowed to escape after the needle is inserted.

Dangers.

Opinions differ very much as regards the safety and reliability of the method. Sicard and his co-workers believe that it is harmless, while more than one clinic in America has entirely stopped its use.

Ayer and Mixter, from experiments on animals, found that there was a meningeal reaction that reached its height a day or two after the injection. There was a rise in the cells up to 1000 and a moderate increase in the protein; the reaction passed off entirely in ten days.

In one of our cases in which the injection was repeated after a few days, the cerebrospinal fluid was found to be definitely turbid and under high pressure. Sharp and Peterson are of the opinion that lipiodol in its present irritating and non-absorbable quality is not safe for injection. In one of their cases a good deal of inflammatory reaction occurred, causing the patient's symptoms and signs to increase very much and necessitating its removal by laminectomy four and a half months after injection. Encysted globules of lipiodol were found surrounded by dense and recent adhesions.

The usual irritative symptoms are: (1) increase in the root pains, (2) pain and stiffness in the back at the seat of injection, (3) headache, insomnia and some rise in temperature, the fever reaching its maximum in a few hours and subsiding the next day.

Ebauch and Mella found that pains in the legs occurred in 30 per cent of cases, rise of temperature in 23 per cent, nausea and headache in 7 per cent, leucocytosis in 30 per cent, and pleocytosis in 60 per cent. Sleeplessness and restlessness were frequent.

From the above data it appears that the substance is not entirely free from harm, as claimed by Sicard, and it should only be used with the strictest precautions.

It may be well to quote here from Armour's Lettsounian lectures the following rules which he has formulated for cisternal injection of lipiodol.

"(1) It should in no way usurp the place of careful and repeated systematic clinical examination of the case. Recourse to it as a labour-saving device and a short cut to diagnosis and localization cannot be too strongly deprecated.

(2) It should not be used unless the possible dangers and complications are outweighed by the more exact localization likely to be obtained.

(3) Finally, in properly selected cases, we have in lipiodol a definite aid in the study of spinal cord compression."

With these rules we entirely agree, and would like to advise against its indiscriminate use. Most of our cases suffered from some after-symptoms, and one developed retention of urine for twenty-four hours following the injection, but where assistance is required in the investigation of a case suspicious of being a spinal tumour we have no hesitation in recommending its employment.

Interpretation of Results.

In the absence of a block, lipiodol passes quickly into the sacral *cul-de-sac* and is seen there after five or six minutes in the form of a large globule; in other cases arrest of the lipiodol either partial or complete occurs.

(*a*) Partial arrest: this may occur normally in the upper dorsal region (called false arrest by French writers); this part of the canal is very narrow and the lipiodol will appear as big drops separated from each other; X-ray taken a few hours later will show that all the lipiodol has gone down. Lipiodol may also be arrested at the seat of the injection if the needle did not enter the cisterna. In such cases a lateral view will show the lipiodol lying outside the spinal canal.

Partial arrest may occur in such pathological conditions as chronic leptomeningitis or pachymeningitis, early compression, swelling of the cord from inflammation, intramedullary tumours, etc.

(*b*) Complete arrest is due in the majority of cases to intradural tumours. Lipiodol is held up permanently at the upper level of the block and it may exhibit a straight or a curved lower border. It is in these cases that the injection gives valuable help. Sicard and Forestier claim to have accurately located by this method thirty-seven spinal cord tumours, in more than half of which there were no objective sensory changes.

Negative Findings and Confusing Results.

Lipiodol may give negative results in the presence of a tumour if it is small in size or of a destructive nature; on the other hand, occasionally a positive result may be obtained and no block found at operation. De Martel reported four cases of this nature where he found no adequate reason for the arrest at the time of the operation. This occurred in one case under our care.

Again lipiodol may occasionally be held up some distance above the tumour, probably from œdema or inflammatory swelling of the cord. In one of our cases lipiodol showed a definite block at the level of the first dorsal vertebra, but when exposed at operation no block or any indication of a pathological change was seen at this level. The patient died some time after the operation and the post-mortem showed an extradural abscess just below the seat of the laminectomy at the level of the third, fourth and fifth dorsal vertebræ.

In the great majority of cases, however, lipiodol is of the greatest value in confirming a careful clinical diagnosis of spinal tumour.

CASES.

The following cases recently under our care show certain points of interest.

I.—*Fibromyxoma of the Spinal Cord.*

Patient A. H. M., aged 19 years. Hospital No. 5948. Occupation, farmer. Admitted April 11, 1931.

Complaint and History.—Inability to move both lower limbs.

Disease began two and a half months ago with severe sawing pains in the region of the upper dorsal vertebræ; the pain was more severe at night. Together with this there was heaviness in his left lower limb with tingling in the sole of the foot.

After about a fortnight the pain in the back disappeared but the right lower limb started to become weak. Gradually he became unable to move his lower limbs, which were held in extension and he could only flex them by scratching the inner part of the thigh (flexor reflex).

There was no past history of injury, syphilis or any important disease, and no family history of importance.

Examination.—Nervous system: mental condition normal; cranial nerves normal.

Motor power: weakness of upper limbs; complete paralysis of lower limbs which were held rigid in extension. There was some atrophy of the small muscles of the hand.

Reflexes: deep reflexes were present and normal in the upper limbs; markedly exaggerated in the lower limbs; definite ankle clonus.

Superficial reflexes: abdominal and cremasteric absent on both sides.

Plantar responses: extensor on both sides and the receptive field was very wide. Strong stimulation of any part of the lower limbs gave rise to the typical flexor withdrawal reflex.

Sphincters: some hesitation in starting the act of micturition.

Sensations: superficial lost as high as the nipples; deep sensations lost in lower limbs.

Investigations.—Wassermann reaction negative in blood.

Cerebrospinal fluid slightly yellow; clotted rapidly.

Albumin 0·8 per cent; no increase of cells; colloidal gold normal.

Pressure 120 millimetres of cerebrospinal fluid, slight rise on pressure on jugulars to 200 millimetres of water and slow fall; feeble respiratory excursions and only slight rise on coughing, indicative of partial block.

X-ray: ordinary X-ray examination showed no abnormality. Lipiodal was injected into the cisterna magna and X-ray then showed a definite block at the level of the upper part of the body of the sixth cervical vertebra.

Progress.—Patient developed retention of urine with overflow on the third day after admission into hospital; incontinence of fæces on April 22. Sensory loss progressed to second intercostal space with slight anæsthesia on ulnar border of both hands.

The triceps reflexes became absent on both sides; supinator present on right but absent on left; biceps present on both sides but weak.

In view of the progress of the lesion and the high situation of the block, urgent surgical interference was thought necessary, and the patient was transferred to the surgical side.

Patient was operated upon on April 26.

Laminectomy fifth cervical to first dorsal. Spinal canal opened and dura exposed and was found very swollen. During the operation the condition of patient became unsatisfactory, and it was thought advisable to postpone the rest of the operation to another day and the wound was closed without the dura having been opened; the patient died next day from respiratory failure.

Post-mortem.—An elongated tumour, subdural in situation, was found very loosely attached to the cord lying on its posterolateral aspect on the left side opposite the lower part of the cervical enlargement about the level of the fifth cervical vertebra. It was about the size of a date stone and of a fairly soft consistency and a yellowish white colour. Microscopic examination showed it to be a fibromyxoma.

FIG. 1.—*Case* 1. Showing part of the spinal cord with tumour exposed at post-mortem after incision through the dura.

Comment.—This case demonstrated beautifully the phenomenon of paraplegia in extension and the flexor withdrawal response ; it also showed definitely the loculation syndrome and conformed with Stookey's findings on the spinal pressure in partial block. It is evident from the result of the operation that mere removal of the vertebral arches does not relieve compression if the dura is left intact, and this case indicates the necessity of opening the dura in a two-stage operation prior to closure of the wound; such a procedure would most probably have saved this patient's life.

II.—*Endothelioma of the Spinal Cord.*

Patient H. A. M. Hospital No. 2021. Aged 50. Occupation, painter. Admitted February 8, 1931.

Complaint and History.—Patient was normal till three months ago; then while working he felt sudden severe pain in lower part of vertebral column. After two days severe pain occurred in lower part of the legs; this was more marked on right side, causing patient to sleep on the left.

At first the patient was able to carry on his work, but after seven days

he became unable to extend his back or stoop and walking became very difficult.

There also occurred some difficulty in initiating the act of micturition.

No past history of syphilis or any disease of importance.

Examination.—Nervous system: mental condition normal; cranial nerves normal; upper limbs normal.

In the lower limbs, the muscles were flabby and the limbs definitely weak, the right more than the left. Sensations superficial and deep intact. Knee-jerks weak; ankle-jerks normal and the plantar reflex flexor. Abdominal reflexes present. Sphincters normal.

Heart and lungs normal.

There was some rigidity of the spine and slight tenderness in the lumbar region.

Investigations.—On lumbar puncture, a few drops of yellow cerebrospinal fluid came out; no effect was produced by coughing or pressure on the jugular veins, indicating complete block, cerebrospinal fluid showed typical "loculation syndrome." Yellow in colour. Albumin, 2·6 per cent. No excess of cells.

Colloidal gold test normal. Wassermann reaction negative in blood and cerebrospinal fluid.

Cisternal Puncture.—First attempt failed perhaps because too much novocain had been used for local anæsthesia and the needle consequently was not sufficiently introduced.

On the second attempt, which was successful, the needle was introduced to half a centimetre beyond the five-centimetre mark. Patient felt pain when the needle pierced the dura.

He stated that the shooting pains disappeared, and the weakness became more marked after the injection of the lipiodol.

Myelography showed a complete stop of the lipiodol just at the level of the space between the eleventh and twelfth dorsal vertebræ.

Progress.—March 18, 1931. Knee-jerks absent; ankle-jerks present. Plantar reflex, extensor on left side and flexor on right. Doubtful anæsthesia in feet; deep sensations normal. Patient unable to move right lower limb. On March 28 he was transferred to surgical side; operated on April 1.

Tenth, eleventh, twelfth dorsal and first lumbar laminæ removed and spinal canal opened.

A tumour was found lying over the posterior and lateral aspects of cord opposite the lower part of eleventh, twelfth dorsal and first lumbar vertebræ. It was extradural; fleshy, dark red in colour, soft and non-vascular, separated easily from cord. It was removed.

Pathological report, endothelioma.

April 4.—Practically no change, knee-jerks abolished on right side, ankle-jerk present on left; sensation intact and sphincters normal.

April 6.—Patient able to move slightly the right lower limb; sensations and jerks as before; no sphincter trouble.

April 16.—Recovered a good deal of power in right lower limb, no sensory changes, ankle-jerks present on right side but knee-jerks still absent, incontinence of fæces developed, patient feels the desire to defæcate but cannot control it.

April 24. No further progress; incontinence of fæces is still present, motions are liquid and mixed with blood.

May 21.—Patient retransferred to medical side still suffering from diarrhœa, but regaining power in lower limbs slowly.

Sigmoidoscopic examination showed the presence of amœbic ulcers and *E. histolytica*, the diarrhœa disappeared rapidly on treatment. The patient was able to walk without any support by the end of June.

Comment.—This patient first complained of pain in the back, shooting pains down the lower limbs and was admitted as a case of sciatica. It was only after careful neurological examination aided by lumbar puncture and lipiodol that the correct diagnosis was arrived at.

The result of the operation was very satisfactory, patient regaining full power in both lower limbs.

The difficulty experienced in the cisternal puncture emphasizes the importance of not using too much local anæsthetic preparatory to making the puncture. The case is also interesting in that the cause of the diarrhœa after operation was an amœbic infection and had nothing to do with the spinal condition.

III.—Upper Dorsal Neurofibroma.

Patient A. K. aged 29. Hospital No. 12364. Occupation, clerk. Admitted May 3, 1931, complaining of pain along the inner side of the right arm and girdle pains around the upper part of the chest. He stated that he had had treatment for some time before entering hospital but had obtained no relief.

Examination showed some wasting of the small muscles of the right hand but no sensory change or other alteration could be detected. Examination was made and a cervical rib excluded.

After admission, the pain remained almost constant and was not relieved by any form of treatment.

Lumbar puncture showed fluid not under pressure; pressure on the jugulars failed to produce any rise in the manometer reading—indicative of a block. Cerebrospinal fluid examination showed increase of proteins, 0·50 per cent, and the Wassermann reaction was found positive.

It was considered that the block might be due to a syphilitic condition, and patient was put on antisyphilitic treatment without, however, any benefit.

X-ray with lipiodol was then carried out and a block was shown, the oil being held up at the level of the first dorsal vertebra (see fig. 2).

Patient was operated on and a fibroma was found, size three by one centimetre, at the level of the first dorsal vertebra inside the dura and attached to it.

It was easily removed, the patient made an uninterrupted recovery, the pain being relieved and the wasting in the hand gradually disappearing.

Comment.—This case illustrates how a positive Wassermann may be

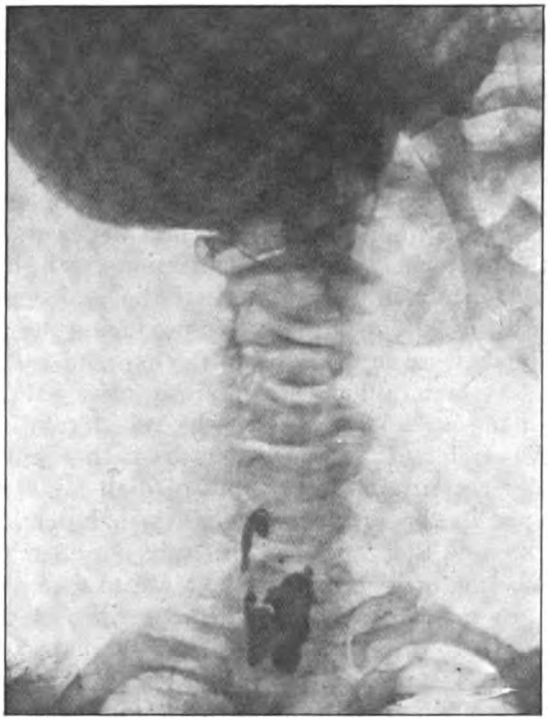

FIG. 2.—*Case* 3. Antero-posterior view showing lipiodol held up at the level of the first dorsal vertebra.

present without having anything to do with the patient's symptoms, and emphasizes the importance of searching for another cause where the result of antisyphilitic measures is unsatisfactory.

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Editorial.

DIET AND TEETH.

THE third of the reports written by Mrs. Mellanby for the Medical Research Council on the Effect of Diet on Dental Structure and Disease in man has just been published.

Mrs. Mellanby commenced her researches in 1917, and in the two previous reports she described the experimental work on animals that led her to believe that there was a definite relation between the presence of vitamin D in the diet and proper calcification of the teeth, and that vitamin A largely determined the structure of the periodontal tissues and their power to resist disease. Methods for producing periodontal disease (pyorrhœa) in animals were successful, but the experiments on caries were inconclusive. It was found difficult to produce caries in animals, so that for the crucial test the investigation had to be transferred from animals to human beings. A search had to be made to see whether and to what extent diet, and especially certain specific factors of diet, might prove to be of primary significance in the incidence of caries in human teeth.

In 1895 Black wrote that "neither structure nor chemical composition is in any degree a factor in predisposing the teeth to caries, or in hindering its inception or progress." In 1890 Miller described dental caries as a process consisting of two stages: In the first bacteria produce acids from the débris of the food stagnating in contact with the enamel, and the inorganic salts of the enamel and later of the dentine pass into solution; in the second stage proteolytic bacteria enter the dentine tubules, destroying the organic matrix so that the tooth is gradually disintegrated. Until Mrs. Mellanby's researches were published, the view that caries was due to bacterial decomposition of carbohydrates in the mouth, the tooth playing a passive part, was universally accepted, and the prevention of caries was regarded as largely a matter of oral hygiene.

Mrs. Mellanby planned her investigations to prove the truth of the hypothesis that the invasion of dental tissue by micro-organisms depends mainly on the structure and the metabolic and nutritional condition of the tooth itself, and of the body fluids bathing the tooth; that caries-producing organisms and food débris may be present in the mouth, but that the initiation and spread of the disease is determined largely by faulty structure and diminished resistance.

Mrs. Mellanby had first to decide what should be considered a normal tooth. Work on animals had shown that the best calcified teeth were creamy white, smooth and shiny in appearance, and that the enamel was relatively thick and regular in outline, showing on microscopical examination comparatively little pigmentation and with a regular systematic

arrangement of the prisms. The dentine was also relatively thick and showed no poorly calcified areas. Throughout her report Mrs. Mellanby has regarded teeth of this structure as normal (perfect) teeth. Any tooth not up to this standard is considered as hypoplastic. Whether normal structure can be produced in human beings by dietetic measures is a question, she says, which does not allow of a direct answer at the present time, although evidence is gradually accumulating. If it can be shown that normal (perfect) human teeth resemble in structure the normal (perfect) teeth of animals fed on a diet of known composition, she thinks it would be a fair inference that they also could be produced in man by similar factors, more especially as these factors have been proved to control the teeth of such widely different animals as the dog, rat and rabbit, and moreover are commonly available through food or sunlight for the races with apparently well-developed teeth.

Having established, for the purpose of comparison, a standard for normality of dental structure, it was then possible to examine what relationship, if any, existed between the structure of a tooth and its liability to decay.

As a preliminary to the study of dental defects in man the normal development and the structure of teeth were considered. The complete chemical composition of the teeth—normal or hypoplastic—is not yet known. There is strong evidence that calcium and phosphorus are combined in the form of apatite. The method of deposition of calcium phosphate in the developing teeth is not one simply of the supply of calcium and phosphate; vitamin D is a link in the process and probably exerts a direct influence on the activities of teeth and bone-forming cells. It may play a part in the handing over of suitable calcium and phosphorus compounds, or ions, to the odontoblasts from the blood. Robison and his collaborators have found an enzyme, phosphatase, particularly abundant in developing teeth. This enzyme is capable of hydrolysing hexose monophosphates and diphosphates and other esters, including some of those present in the blood. When the phosphatase effects the hydrolysis of soluble calcium hexosephosphates a deposit of insoluble phosphate results.

A normal amount of calcium is usually present in the blood of rachitic patients, and Robison and Soames found no lack of hydrolysable phosphoric esters in the blood of rachitic rats. It has been suggested that the function of vitamin D is to transform the necessary ionized calcium and the suitable phosphoric ester from the blood to the developing calcifying tissues.

Mrs. Mellanby states that a supply of calcium and phosphorus in suitable form in the diet is essential for the normal calcification of the teeth; for the utilization of these elements vitamin D is necessary. Other substances playing a part in calcification include vitamins A and C, phosphatase, and the secretions of some of the ductless glands, of which a parathyroid hormone appears to regulate the calcium level in the blood.

When describing the development and structure of perfectly formed

teeth Mrs. Mellanby uses the term hypoplasia (meaning under-development) for any departures from the perfect tooth. The ordinary use of this term applies only to certain gross abnormalities of the enamel apparent to the naked eye, called in the report gross hypoplasia. It is usually stated that such varieties of hypoplasia are only present in 1 to 5 per cent of deciduous teeth, and in about 10 per cent of permanent teeth.

Mrs. Mellanby describes the routine method adopted for examining the surface texture of deciduous and permanent teeth either in the mouth or after shedding or extraction. In deciduous teeth gross hypoplasia visible to the naked eye, such as deficiency of enamel in certain regions, was found in from 1 to 3 per cent. Very few teeth, however, had a smooth shiny surface; the majority showed irregularities of some sort. Similar defects were found in the permanent teeth.

Histological examination was found to be the most satisfactory method of gauging structure. As regards enamel it was difficult to interpret many of the variations in structure, but in grading structure the following were the main points taken into consideration: thickness in regard to type of tooth and position of the section, irregularity, pigmentation, and also the presence of fibres and other markings.

The dentine of deciduous teeth showed the following abnormalities: (*a*) decrease in equality; (*b*) presence of interglobular spaces or areolar tissue. It is commonly said that interglobular spaces are not necessarily an indication of defect, as they are normally found in some animals, notably in the cetacea and in horses. But Mrs. Mellanby found interglobular spaces were rare in the teeth of animals living under natural conditions, but in man who lives under artificial conditions their presence is the rule rather than the exception. The teeth of dogs fed on a proper calcifying diet have a smooth glistening enamel and the dentine is free from interglobular spaces; but if the diet is deficient in certain factors, rough and pigmented enamel results and the dentine contains many interglobular spaces In the permanent teeth interglobular spaces may be formed at an earlier stage of development than in the deciduous teeth, and often close to the enamel.

Mrs. Mellanby found there was a definite relationship between the surface texture of a tooth and its histological structure. By careful examination of the surface enamel it was usually possible to predict the histological structure of both the enamel and the dentine, so that a rough diagnosis not only of the texture of the surface but of the minute structure could be made while the tooth was still in the mouth. By this means she found that the teeth of children of this country are largely defective in structure. Over 2,000 teeth of which sections had been made were examined. About 80 per cent of the sectioned deciduous teeth had some defects. The incisors were the best calcified, only about 40 per cent being hypoplastic as against over 90 per cent of the molars.

The next step was to determine the association between dental structure and susceptibility to caries. There is no evidence based on animal experi-

ments of any direct relation between structure of teeth and liability to caries. As regards human teeth it had been asserted, especially by Black, that structure had no bearing on the liability of teeth to decay. In 1923, however, Pickerill stated that defective structure of the surface of the permanent teeth lessened their resistance to caries.

Mrs. Mellanby examined 1,500 British and foreign deciduous teeth and found that normal structure is associated with a low incidence and degree of caries, that caries is more extensive in hypoplastic teeth, and that it is most extensive in teeth showing hypoplasia of a severe degree. There was no evidence of decay in 78 per cent of the teeth with well-calcified (normal) dentine and only 7·5 per cent. showed a severe degree of the disease, whereas in very hypoplastic teeth only 6 per cent were free from caries.

Where the surface texture of the enamel was described as normal, 83 per cent of the teeth were found to be free from caries. The teeth of two groups of children were examined, and in both groups those with smooth surfaces (normal) were nearly all caries-free, while the majority of the hypoplastic teeth were very carious. Mrs. Mellanby writes, "It can therefore be stated as a general hypothesis that there is a close direct association between structure and caries."

The results of the examination of children indicated that those from poorer homes were more liable than others to have imperfectly calcified teeth with greater tendency to decay. Such children and their parents get less often foods helping calcification, such as eggs, milk and butter, and a greater proportion of the cheap anti-calcifying cereals.

When an erupted tooth is subjected to an external stimulus such as attrition, the odontoblasts of the pulp chamber respond by laying down new, *secondary*, dentine. Experiments on animals showed that with a diet of high calcifying value there was abundant well-calcified secondary dentine, and with a diet of low calcifying value badly formed deficient secondary dentine resulted, a clear proof that the reaction of erupted teeth to external stimuli can be controlled by nutritional factors.

These facts were held to explain the 168 cases which were found to be exceptions to the general hypothesis that there is a direct relationship between primary structure and caries. Examination showed that where apparently normal teeth became carious there was defective secondary dentine.

Mrs. Mellanby, therefore, believes that the incidence of caries in human deciduous teeth is subject to two main principles: (1) the better the structure the less the susceptibility to caries and vice versa; and (2) apart from the primary structure the resistance to caries can be altered by some of those factors which also control calcification.

This second hypothesis, that the resistance of a tooth to external stimuli can be changed by variations in diet, suggested that caries in children might be controlled by those specific substances which have been found experimentally to modify the formation of secondary dentine.

Investigations were therefore made on children living in institutions where factors of diet and environment could be changed at will, within limits consistent with the health of the children.

Four investigations were carried out at Sheffield on children suffering from bone tuberculosis. The children lived under excellent hygienic conditions and the diet judged by all ordinary standards would be considered generous. The main results of these investigations showed that a diet rich in vitamin D and calcium and devoid of cereals has greater inhibitory and curative effects in dental caries than any diet previously tested. The spread of caries during the feeding period was so small as to come within the margin of experimental error. The gradual hardening of the soft dentine and the arrest of caries was one of the characteristic changes brought about by diets with a high vitamin D content. The omission of cereals from such a diet appeared to increase the process.

To test the problem further and on a larger scale an investigation was begun at Birmingham in 1928, by the Medical Research Council, on the advice of the Dental Disease Committee. The children on whom the tests were made came almost exclusively from poor families and were not at the time suffering from any specific disease. They were housed in three institutions arranged on the "Cottage Home" system. One test lasted for a period of two years and the other one and a half years. The Birmingham results fully confirmed those previously obtained in Sheffield and showed that vitamin D is an important factor in checking the initiation of fresh caries, diminishing the spread of old caries, and arresting the infective process in many carious teeth.

Mrs. Mellanby points out that the geographical distribution of dental caries in man can be explained on the experimental data already described. The results of these investigations suggest that caries would be prevalent in countries like Great Britain where breast-feeding is not general or prolonged, where the milk and egg consumption is low and where cereals form the bulk of the diet.

Immunity to dental decay is found in communities distributed in tropical, subtropical, polar and temperate zones. An outstanding fact is that in these communities prolonged breast-feeding is habitual; it is found both in the tropics and in arctic regions; it is practised in the Western Hebrides and in Tristan da Cunha, where rickets and dental caries are almost unknown. During an important stage of tooth development breast-feeding ensures the optimum calcifying effect, especially if the maternal diet is adequate. In the first Report Mrs. Mellanby showed the importance of maternal diet during pregnancy and lactation to the future calcification.

A second important fact is the comparatively large amount of vitamin D obtained by the immune peoples. The vitamin is sometimes obtained from the food, and sometimes produced by exposure to tropical sunshine with a minimum of clothing. A high carbohydrate diet such as is eaten

in the tropics and in Tristan da Cunha is compatible with the production of good teeth, immune to caries so long as the intake of vitamin D, calcium and phosphorus is sufficiently high, especially in early life.

In order to reduce substantially the incidence of dental disease, especially in temperate zones, Mrs. Mellanby considers that it is necessary to introduce large changes in the diet of pregnant and lactating women, of infants and of children during the whole period of dental development. The consumption of milk, eggs, cheese, animal and fish fats, and vegetables must be increased and the consumption of cereals correspondingly diminished. Breast-feeding must be general and prolonged. Cod-liver oil or some other source of fat-soluble vitamin should be given to all children and infants.

The value of Mrs. Mellanby's work is generally acknowledged. In the United States there has been a great development of nutritional investigation on dental tissues which has largely confirmed her results. In the Annual Report of the Medical Research Council for 1932-33 it is stated that the White House Conference on Child Health and Protection considered that "studies more specifically directed towards the control of dental caries have recently emphasized that active caries should be regarded as indicative of dietary deficiencies," and quoted the statement that "practically all students of the problem concur in the opinion that an adequate well-balanced diet is inhibitive to the disease."

Mrs. Mellanby's work has indeed revolutionized the views formerly held on the causation of dental caries, and it only remains for the general community to take advantage of the facts she has placed at its disposal.

Clinical and other Notes.

ON THE VALUE OF PIGNET'S INDEX.[1]

By Colonel BALANESCO,
Roumania.

However efficient the hygienic arrangements in an Army may be, service is hard and produces many disabilities. It is necessary, therefore, to have men who are quite fit. For this reason medical examination is made on enrolment. The selection should be made with great care and be based on adequate medical knowledge. The ordinary method of examination leaves much to be desired, in that it is too hurriedly carried out, often by medical officers selected at random. On account of lack of time or experience and especially the fear of suspicion, unfit men, those actually ill and those suffering from latent tuberculosis, and much worse those suffering from active tuberculosis, are frequently accepted. Recently in Roumania the recruitment has been carried out in two stages as suggested by Maujan.

The Recruiting Medical Officer makes the first examination, and refers those unfit to another commission formed of Senior Medical Officers who alone are empowered to decide which men are unfit for service. In the ordinary way two forms of medical examination are carried out: in the first, the usual measurements, height, chest measurement, weight and various co-efficients, and in the second the essential medical examination, including auscultation, X-ray examination and various biological reactions. In view of the large number of conscripts the medical boards rely on the ordinary examinations and various indices and co-efficients which to my mind have little or no value.

In the most favourable circumstances co-efficients should be regarded as presumptive signs guiding the medical officer to a certain extent in borderline cases. We have made use of a series of co-efficients which have proved to be of no value, viz., the anthropometric quotient of Buchard, Tartiere's criterion, the indices of Koby and Meo, the tests of Mackiewicz and Campus-Hugneney, and of course the better known Index of Pignet. The last named is much used in our Army, but unfortunately it has not a decisive value.

In support of this finding we ascertained in 1926 the Pignet Index on

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[1] Paper read during the Third Session of the International Office of Military Medical Documentation, Granada, June, 1933. Published in the *Bulletin International.* Translated by Lieutenant-Colonel A. D. Stirling, D.S.O., R.A.M.C.

500 confirmed tuberculosis cases at Bucarest and found that the index varied from 0 to 57. The majority had an index of 26 to 30 on Pignet's scale. The mean figure was 28, which indicates a physical state compatible with military service.

The following table gives the results found :—

TUBERCULOUS CASES.

34·57 per cent	2·15	per cent	with	index	0–10	= very robust constitution
	5·57	,,	,,	,,	11–15	= robust constitution
	6·28	,,	,,	,,	16–20	= good constitution
	20·57	,,	,,	,,	21–25	= fair constitution
	22·0	,,	,,	,,	26–30	= poor constitution
	21·43	,,	,,	,,	31–35	= feeble constitution
	22·0	,,	,,	,,	36–57	= very feeble constitution

From this we see that 34·57 per cent of confirmed active tuberculous cases have a very good Pignet Index within the standard of fitness for military service. 43·43 per cent have an index corresponding to a poor or feeble constitution, which many regard as being compatible with military service. 22 per cent have a high Pignet Index and are below the standard for military service.

Thus we see that if this Index is accepted seventy-eight per cent of tuberculous cases would have figures within the limits of fitness for military service.

This year I ascertained the Pignet Index of 100 cases of pulmonary tuberculosis at Bucarest which was as follows :—

47·7 per cent	6·2	per cent	with	index	0–10
	8·3	,,	,,	,,	11–15
	12·4	,,	,,	,,	16–20
	20·8	,,	,,	,,	21–25
41·78 ,,	30·20	,,	,,	,,	26–30
	11·58	,,	,,	,,	31–35
	10·5	,,	,,	,,	36

These figures correspond to the previous ones with the sole difference that the percentage with a good Pignet Index is more favourable. This is due to the fact that during recent years as the result of frequent medical examinations recognition of the disease has been more prompt before wasting has taken place.

From the mean of the figures obtained in these two series we can appreciate the minimum value of the Pignet Index.

If we admit the limits set by various authors, 30 to 31 (Besson), 32 (Papin), then more than 65 per cent of our tuberculous cases have an index of fitness considered as sufficient.

Even with the ideal figure of 25 we find nearly 41 per cent of these cases are included. There is no need to exaggerate. We should not give up using such co-efficients but we should make judicious use of them. Their variation from the accepted limit Pignet of 25 might serve as a means of "sensitization."

In cases where the figure varies between 22 and 28 clinical and radiological examination should be made.

Modern scientific requirements demand strict examination of every conscript. Each one should have a card (a medical identity card) with all the information possible—the results of X-ray examinations, biological tests, anatomical measurements, mental tests and such like.

I know the great difficulty in carrying this out and I suggest that during the first six months of incorporation all young soldiers should be examined radiologically, as the renowned sociologist Dr. Schreiber has already recommended.

As chief of the military centre for tuberculous cases in Bucarest for twelve years I have had the opportunity of seeing a large number of conscripts, soldiers, and healthy military pupils without any clinical signs—percussion and auscultation normal. On radiological examination of these young people with a Pignet Index under 25, I found old pleuro-pulmonary affections, latent cases with apical and basal adherent pleura, calcified nodules at the hilum or intrapulmonary, and active cases—glandular or pulmonary—with diffuse opacities.

Many cases of active tuberculosis previously considered unfit reappeared in this group of individuals, considered healthy, but with the X-ray evidences noted above.

VACCINATION OF ROYAL TANK CORPS RECRUITS.

By Major S. J. L. LINDEMAN, M.C.,
Royal Army Medical Corps.

All recruits found medically fit for service on joining the depot are vaccinated immediately before being finally approved. In two and a half years only one man has refused to be vaccinated, and as he persisted in his refusal he was discharged at once without being finally approved. Those at present under consideration are a thousand consecutive vaccinations.

The method adopted was as follows : The outer aspect of the left upper arm was wiped over with a swab soaked in methylated spirit. The lymph was blown out on to the cleansed area. An ordinary straight surgical needle was used : it was kept stuck in a rubber cap bottle of spirit and the end flamed before each vaccination. Three marks were made. Each mark consisted of one stroke quarter-inch long in two directions making a small cross. The first cross was made one and a half inches to one side of the blob of lymph and was the control mark. The second cross was made through the blob, and the third one and a half inches on the other side of the control. The lymph was gently rubbed over the two marks with the flat of the needle and the arm allowed to dry for ten minutes before the pad was applied. The operation should be gently and carefully performed. During the temporary absence of the writer a new medical officer carried out the vaccinations more boldly and vigorously, with the result that the percentage of admissions to hospital from that batch went up enormously and some were attending for six weeks after.

It was found in the earlier part of the series that a certain proportion of men would collapse within a few minutes of being vaccinated. This curious phenomenon does not appear to be an ordinary faint but more in the nature of a fit. Either with or without previous warning of pallor a man would crash on to the floor completely unconscious. There would be some jerking and twitching of the limbs and eyelids for about a minute, then a sudden and complete return to consciousness. Usually the patient would wake up and look round in a surprised way and make some remark as, "What's happened, I'm all right." Almost immediately he would be quite normal again and not at all faint, dazed or drowsy. Since making a rule that all men must sit down immediately after being vaccinated and remain sitting down for at least five minutes, no further cases of this condition have occurred.

In this series there were—

Primary vaccinations	270
Re-vaccinations	730

RESULTS OF PRIMARY VACCINATIONS.

Two perfect vesicles	257
One perfect vesicle	4
Papules only	6
Failures	3
Total ..	270

In reading the results there can never be any doubt as to those with vesicles. Those which showed any less reaction in the two marks compared with the control were considered as papules only. Of the failures one failed three times and two had two vesicles at the second attempt.

Severity of Reaction.—Fifty-nine or 21·85 per cent of those not previously vaccinated reacted so violently that they had to be sent into hospital. The average stay in hospital was 8·8 days. The symptoms complained of were: Fever, giddiness, headache and constipation, in addition to local inflammation and painful axillary glands.

Those with less severe reaction were treated in barracks and usually attended for about a week. It was found necessary to mark them "Attend 'C'," but it was understood they could attend lectures and schools. If marked "Attend 'B'" only, it was difficult to prevent enthusiastic N.C.O.'s putting them on drill and fatigues. If made to do heavy manual work it naturally aggravated the condition and probably necessitated their admission to hospital. The best local treatment was found to be starch, zinc and boric dusting powder freely sprinkled on the arm and covered with a light gauze dressing. Although many had high fever and very extensive and severe local cellulitis these subsided in a few days and there were no complications.

Re-vaccinations.—Two hundred claimed to have been vaccinated within the last ten years, and of these only fourteen developed vesicles and none was admitted to hospital; 500 had been vaccinated in infancy only.

RESULTS OF RE-VACCINATION.

Two perfect vesicles ..		..	..	203
One perfect vesicle ..		..	..	45
Papules only	..	..	..	475
Failures ..	..	..	..	7
		Total	..	730

Of the failures—

1 failed three times
3 had perfect vesicles at the second attempt
3 had marks of recent vaccination and were not done again

Severity of the Reaction.—Nine, or 1·2 per cent, re-vaccinations reacted so violently as to be admitted to hospital. They were all men who had only once been vaccinated in infancy.

The following points are brought to notice by these figures :—

(1) That probably approximately twenty-seven per cent of the civil population are unvaccinated.

(2) That in primary vaccinations the results are almost always perfect.

(3) That the reaction to primary vaccination in adults is apt to be severe.

(4) That the reaction to re-vaccination is seldom severe if the primary vaccination was done many years ago.

A CASE OF MYOTONIA CONGENITA.

By CAPTAIN W. PARSONS,
Royal Army Medical Corps (T.C.).

THE following notes on a case recently admitted to the Military Hospital, Colchester, would appear to be worthy of record in view of the extreme rareness of the disease and also for comparison with the interesting case of a similar nature reported by Captain M. R. Burke, R.A.M.C., in the Journal of September, 1933.

Private C., aged 21½, with three and a half years' service in a Scottish regiment, was admitted to this Hospital on September 5, 1933. He stated that he noticed nothing unusual until December, 1932, when he became conscious of "a gripping of the muscles of his legs" for the first few steps on commencing to walk. This sensation passed off after he had walked a little distance. He had often been pulled up on parade for his slowness in drill, and particularly when receiving an order to quick march, after he had been standing to attention. He also experienced difficulty in rising from any seat or form on which he might have been sitting for any length of time.

On examination, the muscles of the upper and lower limbs were found to be very fully developed, almost to a degree of hypertrophy, which gave him the appearance of being a very strong man. When asked to shake hands he experienced difficulty in making the grip, and on relaxing the grip the hand was left in a typicalc law-like position which lasted for

about eight seconds. On repetition of this movement, however, he could carry it out normally and without difficulty. Other muscles affected in addition to the limbs were those of the face and neck. On commencing to walk he did so with a stiff and unsteady gait for the first dozen steps or so before his steps became normal.

Other manifestations of the disease which he exhibited were :—

(1) When asked to walk upstairs, he had difficulty in negotiating the first few steps and gave the impression that he would fall, but as he ascended he was able to overcome this difficulty.

(2) When asked to look one in the face, his expression for the first few seconds was fixed and had a vacant stare, and then became normal.

(3) When told to assume an expression of surprise by raising his eyelids and forehead the muscles concerned remained contracted for a few seconds before he was able to relax.

(4) On being asked to forcibly blow his cheeks out, with mouth and glottis closed, there was an appreciable delay before he could relax the sterno-mastoid muscles on being told to breathe normally again.

The muscles of the trunk were not affected. Reflexes deep and superficial were present, but sluggish in response to stimuli. The eye reflexes were normal, Wassermann and Kahn tests were negative, urine was normal, there was no abnormality detected in the heart, lungs and abdominal organs.

Electrical Reaction Test.—Faradism : delayed contraction on first application ; contraction maintained for several seconds after breaking the circuit. After three applications reaction normal.

Galvanism : Similar delay on closing the current with a more appreciable delay before relaxation on opening the circuit. After a second application, reaction was normal.

After an interval of two or three minutes the above results were again obtained.

Family History.—The man has two brothers, both of whom are affected in the same way. He states that his second brother's eldest child, a boy, aged 6, is at present in the Edinburgh Infirmary with the same complaint.

His father was supposed to have had the disease as a young man and to have "grown out of it." There was no psychoneurotic or hysterical element in the case.

Treatment on the usual recognized lines was of no avail. The patient's health while in hospital was excellent. The hereditary incidence in this case together with the characteristic manifestations and the particular muscles affected are the points on which a diagnosis of Thomsen's disease was made.

In conclusion I wish to thank Colonel MacArthur, Consulting Physician to the British Army, who kindly saw the case with me, and confirmed the diagnosis, also Colonel C. D. Myles, O.B.E., A.D.M.S., East Anglian Area, and Lieutenant-Colonel F. C. Sampson, D.S.O., R.A.M.C., for permission to forward these notes for publication.

AN UNUSUAL CASE OF CEREBRAL HÆMORRHAGE.

By Major C. A. Whitfield,
Royal Army Medical Corps.,
and
Lieutenant A. A. Pullar,
Royal Army Medical Corps.

P. C., a girl, aged 13 4/12 years, was admitted to the Louise Margaret Hospital, Aldershot, at 8 p.m. on October 13, 1933.

History.—She had always been a nervous highly-strung child. She periodically suffered from fits of irritability, and had been treated with bromides, without any obvious effect.

She became acutely ill during the afternoon of October 13, whilst at school, vomiting and severe headache being the outstanding features. Shortly after 4 p.m., she had a fit which was diagnosed as epilepsy by her doctor.

She remained unconscious for over an hour and then lapsed into a state of semi-coma from which she could be roused; when so roused she was very irritable.

On the way to hospital she became very violent, and on arrival the two male ambulance attendants required assistance to remove her to the ward.

After being put to bed she soon lapsed into a state of semi-coma, and lay on her left side in an attitude of flexion; she resisted examination vigorously and shouted irrationally.

On Examination.—The heart and lungs showed no abnormality.

The abdomen was markedly retracted. No glands were felt. Peristalsis was active.

Central nervous system: The deep reflexes were normal on the left side; the right knee and ankle-jerks were weak. Babinski's sign was positive on the right, doubtful on the left. Abdominal reflex was absent. Sensation to pain was unimpaired.

Muscles: There was marked paresis of right arm, leg and facial muscles. There was stiffness of the muscles of the neck and limbs. Kernig's sign was positive.

Eyes: The pupils were equal and reacted to light. There was no nystagmus or photophobia.

Lumbar puncture yielded a fluid intimately mixed with blood; samples collected in three different tubes appeared alike. The fluid was under considerable pressure.

Ten minutes after lumbar puncture had been performed, respiration failed, and artificial respiration was carried out for more than two hours before natural breathing was re-established. After this the child lay in an unconscious state in a condition of flaccid paralysis and could not be roused.

Her condition remained unchanged throughout October 14.

Lumbar puncture was repeated at 12 noon on that day, and yielded a fluid intimately mixed with blood, but not under increased pressure.

Her condition showed little change until 6 a.m. on October 15, when respiration took on a Cheyne-Stokes' rhythm, the pulse became steadily weaker and more rapid till she died at 7.30 a.m.

Permission to perform a post-mortem examination was refused.

The cerebrospinal fluid was examined at the Leishman Laboratory and reported on as follows :—

"Globulin, no increase; sugar, normal reduction; smears, no T.B. seen; culture, sterile.

On centrifugalization, supernatant fluid shows very definite hæmolysis.

Film of sediment, cells disintegrated and differential count impossible."

Conclusion.—The history, clinical signs and symptoms, and report on the cerebrospinal fluid fit in with the picture of cerebral hæmorrhage due to congenital aneurysm of a cerebral artery, as described in "Recent Advances in Neurology."

Our thanks are due to Lieutenant-Colonel C. J. Coppinger, O.B.E., R.A.M.C., for his examination of, and report on, the cerebrospinal fluid; and to Major-General J. A. Hartigan, C.B., C.M.G., D.S.O., Deputy Director of Medical Services, Aldershot Command (now Director-General Army Medical Services) for his permission to forward the case for publication.

Travel.

BEYOND LEH.

A SHOOTING TRIP IN LADAKH, 1926.

Being a Diary kept by

K. W. DICKSON, F.R.G.S.

(*Continued from p.* 233.)

XX.—In the King's Garden as Stok.

We had arranged with Mrs. Kunick to go to Stok for one or two nights. The Padre found he had too much work in hand and he could not leave Leh with a peaceful mind. The Tehsildar himself had come to see R. to explain to him that the nullah beyond Stok was preserved, but that with the licence for sharpu he could shoot in the Stok nullah. We started off after lunch from the mission house, Mrs. Kunick on her own little grey Zanskar pony, and I on a hired one; the baggage and two tents had gone on ahead under the care of Khazir But. We left Jit Ram in charge of our baggage and other tents in the compound, and the sweeper to look after Garry and Kelpie. I was loth to leave the dogs, but thought they would be better in Leh if we were only away for one or two nights. I missed them so much in Stok;

I had not realized before what good company they were when R. was out all day. We took three and a half hours to reach Stok. Although Leh looked so near, distance is very deceptive in that clear atmosphere. We came by the same sandy path to the river by which we had come from Shushot ten days before. Mrs. Kunick and I walked almost all the way as it was downhill, and we could talk as we walked.

The willow grove by the river was now carpeted with dwarf irises, a lovely blue against the fresh green turf.

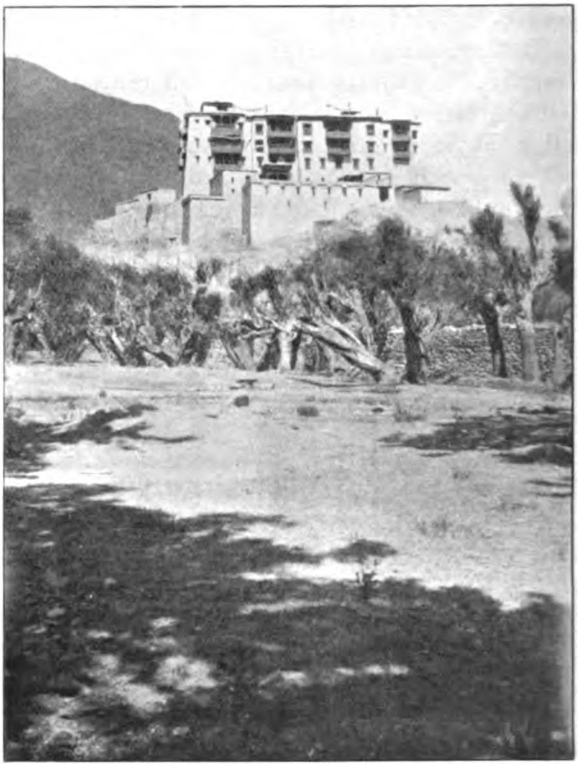

FIG. 23.—The King's palace at Stok.

We saw two men fishing, and bought two good-sized fish for twopence each. We had seen them caught, so we knew they were fresh. That helped to make up for the extraordinary number of bones. We had never been able to have fresh fish for dinner, as candlelight did not show up the bones; nor was it suitable for breakfast before a march, as it took so long to eat.

There were so many high walls in Stok that we could not find the camp, and we hung about for some time before the pony man found it in a walled-in garden just under the castle. Mrs. Kunick had intended to go to the castle to pay our respects to the Queen the same evening, but we had arrived late

and were tired, so we just put our few possessions straight, had dinner sitting on the beds in our tent, and went to bed.

Next morning R. set off with Khazir But before it was light. Mrs. Kunick and I had breakfast at a civilized hour, and shortly after we had finished, the Rajah, or Gyalpo, as Mrs. Kunick called him, came to welcome us. He was accompanied by several servants carrying wood, flour, rice, eggs, milk in a brass vase, and half a cone of butter. It was just like a stage picture of King Alfred and some of his Saxon followers. The men were ragged in natural home-spun coats; their legs were wrapped in pieces of felt tied with black hair braid wound round them like a puttee. The King wore the red robe of the lamas, but his head was not shaved, and he wore his hair in a long pigtail tied to his sash. His cap was of red silk brocade edged with gold, but no part of his dress was fresh or even clean. He had an intelligent face with keen eyes which lighted up when he was pleased or interested, but when in repose a look of hopelessness came over his face. He sent his servants off on various errands until we were alone. We all sat on a small rug as we had brought no chairs or tables from Leh. The King leant forward, and in a quiet but very excited way talked to Mrs. Kunick in Tibetan. She told me that the Queen was ill, and he apologized for not being able to ask us to the castle on that account. He had not been told of our arrival the previous night, or he would have come down himself, and would have sent wood and milk at once. He asked several times if we had all we wanted. Could he not send more wood or more eggs? As it happened we could not have stayed in Stok as long as we did had it not been for the extra food he sent us; so indirectly we were indebted to him and his kindness for a record sharpu. He talked for some time to Mrs. Kunick, always sending any servant who came near off on another errand. He seemed to me like a man who had had his thoughts bottled up for months, and was only now getting an outlet. Mrs. Kunick listened and was clearly most sympathetic. She told me after his departure that there was a great secret which according to their custom must not be told for another month yet. The Queen had given birth to a little son ten days before, and she was still very weak and ill. The news of the birth of the prince must be kept absolutely secret. The lamas said if the news leaked out the evil spirits would change the boy into a girl, or the boy might die. He said the Queen had been very ill, and had lain like wax for three days, not moving or speaking, but now she was a little better, and had sent messages to Mrs. Kunick. It was terrible to think of the poor girl lying in total darkness in that dreary castle on the rock above us. I had heard that after a birth all doors and windows are tightly shut in case the evil spirits get in. As her condition had to be kept secret, probably she had not been outside the walls for some months. The King seemed very fond of her, and was so delighted when we asked if we could send her some chocolate. Sometimes sweets are allowed when food touched or cooked by Christians is forbidden. He asked Mrs. Kunick later, would she make a cake and send it to the

Queen. I am sure he left us a much happier man. I said I would like to see the little Princesses; his face lighted up, and he said he would send them down later with his grandmother, after he had made her tidy her hair. I was very amused when Mrs. Kunick translated his last remark.

Within the hour the old lady arrived with two little girls and a Ladakhi serving woman. A little boy in a lama's purple robe followed them. The old grandmother had been operated on some years before for cataract by Dr. Heber, a former missionary in Leh, and she has sight in one eye. She

FIG. 24.—In the King's garden at Stok. The King and his daughter Urgyan.

had rather a fine old face, very clever I could guess, but I am sure life would be easier in that old castle if she were not there.

Mrs. Kunick asked about the children; the elder was nine, and the other six years old. The elder one was dressed as a typical Ladakhi girl in the purply woollen frock worn long to the ankles, which gives them an old-world look. The younger was dressed as a little nun, in a red robe, with a tiny mitre-shaped cap like a lama. I asked her name, and they said she had been christened "Urgyan" the day before. We thought it a very charming name, but asked why they had waited until she was six years old

before they gave her a name. They had waited, said the grandmother, in the hope that she would turn into a boy. She took off her little cap and proudly showed us her shaven head. She was a dear little girl, and it made me shiver when I heard she was to go to Hemis Monastery in a year or two. Mrs. Kunick had brought small presents for them all, as when the King and Queen visit the mission house they bring presents with them.

It is customary for the King of Ladakh to have not more than two children, so if the new baby had been a girl, perhaps she would have been given away, and her birth might not have been announced at all.

The old lady asked us some very embarrassing questions about our husbands having other wives as we had no children. She sat on long after our efforts at conversation were exhausted, and her servants had told her twice that they were calling from the castle. She simply answered, "I will stay a little longer." As I did not understand the old lady, I played with the children, throwing the balls that Mrs. Kunick had brought them. The little nun was a most attractive child; although she was shy at first, she chuckled with laughter when I pretended to take her ball away. The Kashmiri boy came once or twice with cups and plates and then asked the time. I had R.'s watch, but the old lady took no notice until she had made up her mind to go. I am sure Mrs. Kunick must have been very tired trying to entertain her, I know I was tired sitting doing nothing. She had brought us a dish of dried apricots. Luckily they were the ones from Baltistan which have sweet kernels and require no sugar when cooking, as we had run out of sugar.

R. got back by four o'clock, again disappointed. The following morning the King arrived very early. He did not look at all healthy. What a life for a man, living in that castle with no work to do, and with no real authority; servants given to him and food supplied; just sufficient for his needs; no need for labour, and yet no scope for charity! There is a chapel inside the castle, and I expect the lamas who live there are the real rulers. We heard loud drums and cymbals at regular intervals all day, and they began before seven. I suppose the same noise goes on even if the poor sick Queen has just dropped off to sleep.

Mrs. Kunick once suggested to the King that he should play polo. He said, "Yes, I must; I will get sticks and practise in Stok," but nothing came of it. Probably a lama said that some great evil would befall the King if he played polo. If only Ladakh were under direct British rule the King might travel and have his interests widened and learn how to work. He might even become Wazir, and his son could go to the Chiefs' College in Lahore to be educated.

Somehow since learning so much about the Royal Family, my desire to see the festival at the monastery of Hemis has dwindled. Now that we had seen what influences are at work, our interest in the devil dancers had gone. They were by no means too polite to us at Hemis, and I felt I would rather go up the Khardung Pass if it was possible, than attempt to go to the

festival. All our neighbours at the Dak Bungalow had probably left that day for Shushot on their way to Hemis.

Mrs. Kunick was to have lent me her pony to ride back next day, but the Ladakhi evangelist required it to go to Hemis. He went to preach to the crowds in the intervals between the dances.

Mrs. Kuñick and I stayed in the wood next day, and I heard many interesting things about Buddhism, reincarnations, etc., from her. R. came back about four just as she was leaving for Leh on her grey pony. We stopped and talked to let her take the news to Mr. Kunick. They had seen some wonderful heads, but had come upon them so suddenly round a corner that the herd took fright and were off. They had been watching two others when these beauties appeared unexpectedly from another direction, and the big ones made straight up the hill. R. had his rifle ready and had a flying shot at a very big one. The animal staggered, and they found some blood at the spot, but it bounded off after the others. It was at least cheering to know that there were such heads in the nullah, but we could not spare many more days if we were to attempt the Khardung Pass. This was his thirteenth day stalking sharpu. Another morning on the hill in the hope of having better luck, and then we decided to return to Leh on the Friday morning. There was no sign of any of the large herd on the hills on Thursday; they had probably gone to a bigger nullah to the west which was closed for shooting. It was most disappointing. We spent the afternoon quietly in the wood. As we had not intended to stay so long in Stok we had run out of stores. We had no tea, coffee, sugar, butter or jam, so we had rather unusual meals. Mrs. Kunick had promised to send tea, sugar, and butter from Leh, but the little boy who brought them took eight hours to come with the parcel a distance of eight miles. We had milk and hot water at tea; not a very refreshing drink!

We made an early start next morning as it was beginning to get warm at midday. It was a perfect morning, and the hills looked so beautiful, they might have been the Grampians round Boat of Garten; surely I could pay them no higher compliment! There was an unusual freshness in the air too. We walked to the river where we waited for the riding pony. In the distance there were many people on their way to the festival, which was to begin next day, the 19th of June. At the bridge many pack ponies passed us with Sahibs' baggage, and many Ladakhis in gala dress, making charming colour pictures; even the ponies had coloured saddle cloths.

In the marsh near the river we suddenly saw two storks. R. tried to stalk them with the camera, but although they did not fly away, they just moved as he moved, and kept out of range. After he had snapped them he walked straight towards them, and they stretched their wings and flew a few yards but settled down to eat again.

I had a lazy pony and it would not go without being led. The man got between me and the wind, and I wished I was not so conscious of my sense of smell!

We got back to Leh for lunch, and were kept busy all afternoon looking out stores in preparation for going up towards the pass next morning. We dined at the mission house that night and told Mr. Kunick all about having seen the big sharpu heads after a lot of stalking, and then coming back without one in the end.

XXI.—Castle and Monastery.

After tea Mr. Kunick took us to the castle. I rode Mrs. Kunick's pony, a very sure-footed beast, up the steep hill. We got a fine view of the city even from the entrance. The gateway was surmounted by a great lion whose head moved and mouth opened when a rope was pulled. The castle itself was a collection of great empty rooms with mud floors. There is no glass in the windows, and even at that time of year the wind howled through the corridors. In winter it must have been a terrible place. We went up uneven wooden ladders to get from one room to another. Later a lama came to show us over the chapel. He was quite a pleasant gentleman. Lamas are the only well-fed looking people in Ladakh, and this one was no exception. We climbed to the top storey and stood out on a little balcony. The view was very extensive and gave me a much better idea of the geography of Leh than I had before. The castle is oblong-shaped with sloping walls, which give it an appearance of great strength and solidity. Mrs. Kunick remarked to her durzie one day what a lot of labour must have been employed when it was built hundreds of years ago. He said the building materials, earth and bricks, would probably have been carried to the top by flocks of sheep, each with its small load in its saddle bag.

There was probably more arable land round Leh long ago, as I heard on all sides that the water supply is diminishing. The rainfall has always been negligible, but the snowfall is not what it was. Some of the older inhabitants remember when the barren sandy plain between Sobu and the Indus was covered with pasture.

We next saw the rooms of the King and Queen, the Gyalpo and Gyalmo, as the lama called them. They too were very bare. These rooms are only used when the royal couple come to Leh for the New Year Festival. There were two or three small pieces of furniture, old Kashmiri lacquer work with Chinese designs. A hearth stone in the middle of a room showed where an iron stove had been placed, and the painted roof which had once been beautiful, was begrimed with smoke. The lama took us into the chapel. The first thing I saw was an enormous bowl filled with butter. It was made with a lip turned in round the top to shelter it from the wind; a light is always kept burning there. In front of each god were seven small bowls of butter, then seven small bowls of water. One had fourteen, but always a multiple of the number seven. It made me think of the Tabernacle. One god was the all-seeing, and had eyes everywhere. Under his feet were all mankind and all the beasts of the earth.

We asked the lama to show us how he read his service, so he took us to

an anteroom, and began reading. The reading was punctuated with clashing of cymbals and the beating of a big drum. I wondered if Selah in our Psalms meant the clashing of cymbals. I think Buddhists have many rites and feasts like those in the Mosaic Law. The scapegoat is always one of the tableaux at the Hemis Festival. While reading, the lama held what looked to me like a little hollow brass dumb-bell in his hand between finger and thumb, the palm of the hand upwards. The lama called it a Dorso, and Mr. Kunick said it represented the thunderbolt which was supposed to have fallen at Darjeeling. Dorso the thunderbolt, and Ling a place, hence Darjeeling, our version of "Dorso-Ling." The handle of the bell which the lama used was a model of half of the thunderbolt. The bells come from Lhassa, and were for sale in the bazaar, but since the Americans have been in Leh, prices of souvenirs have increased 200 per cent, and we did not buy one. The vendors were asking about £2 each for them.

In a corner of the chapel proper the lama showed us a pile of trumpets, long and short, made of brass and wood. These are made in Leh, he said. In the same room round the walls was the library, old lacquered stands with piles of old manuscripts rolled in calico, with polished or lacquer boards above and below each pile. This manuscript is painted black, and the lettering is in gold and silver. In any other climate where the atmosphere is not absolutely dry the manuscript would get mouldy and stick together, but these were probably hundreds of years old, and had no other protection than the thin piece of calico. On the far wall of the chapel was another part of the library. Here the stands were made of the roughest poplar boards. The manuscripts were rolled in calico, but there were no polished boards to protect them. It just looked like a poor class laundry with bundles of washing. I asked the lama why the boards were missing and the stands so poor, and he said that many years ago when the Dogra soldiers came to Ladakh they used the old lacquered stands and boards for firewood, and they had never been replaced. He lifted the curtains before some of the idols, the better to let us see them. Most of them are draped with old Chinese silks, now falling to pieces. Banners of old silk representing dragons and goddesses were hung on pillars, the more precious of these having a covering of muslin.

We thanked the lama and suitably rewarded him, then left the castle to climb still higher to the monastery on the hill above. This belongs to a different sect, so the same lama could not show us round. I mounted the grey pony and went as high as possible on her by a path that certainly did not look fit for any animal but a goat, but luckily one gets accustomed to heights and steep paths after some weeks in Ladakh. We first went to a small square building which had nothing inside but one great yellow idol, which in a sitting position is at least 20 feet high. It was draped in old Chinese brocade and had earrings and necklaces of precious stones. The face had the usual long slit eyes turning up at the corners, and the hard supercilious mouth. We mounted still higher to another chapel but found

it locked. The Draba, or boy priest, who was our guide, said he could not get the key as it belonged to the yellow sect, so we went on to the very top of the hill where another of these places is perched on a pinnacle of rock, and here the boy opened a small door. The verandah was falling to pieces; even the roof was in an unsafe condition. The Draba lit one or two joss sticks, the incense they use in these places. Next we went up another storey to a little balcony round the tower where the view was magnificent. Leh and its surroundings lay like a map before us, but the footing was very insecure. In the floor were many loose and missing boards, and the drop below was considerable, several hundred feet I thought as I looked down.

Sightseeing is very tiring, and we enjoyed our evening meal in the mission house that night. Mr. Peter was there, and the talk was mostly of passes and their difficulties, and tales of lone travellers being overcome with mountain sickness. As R. said, if suggestion had anything to do with it, we ought to feel mountain sickness up the Khardung next day, but I was much too keen to get to the top of the pass to worry over stories about other people. Mr. Kunick was not sure if we could manage it. He said the only possibility was to have yaks meeting us to take us up the worst part, so we sent a note to the Tehsildar, asking for two yaks to be sent to Paulo for Sunday morning.

XXII.--The Sharpu Head.

On Saturday we had to give up our Europe mornings and begin our early starts again; early tea at five; and we were on the Yarkund road by half past six. We took two riding ponies, as it was a sandy uphill track to the foot of the pass. It was a cloudy day, but we hoped for better weather on the morrow. A stop was made by the wayside and a fire lit to boil the kettle. The only fuel was a dry grass which grew in tufts among the rocks and had a strong aromatic smell. We heard marmots, but did not see many. There were a few yards of turf on either side of the stream most of the way up, except where the stream disappeared altogether under large boulders. On this scanty pasture yaks and donkeys were grazing. We camped on this narrow belt of turf not far below a little stone hut which looked as if it had been built for animals, rather than for men to sleep in. R. went off almost at once with the shikari and tiffin coolie up the nearest nullah in the hope of seeing sharpu. It seemed as if we would have to return to Kashmir without one. It was much colder than it had been in Leh, and a strong wind blowing, but it was in reality not nearly so cold as we had experienced before, and we had quite a comfortable night.

After tea and eggs at 4 a.m. we got up and dressed, and were off by 5 o'clock. We looked about for the yaks but none appeared. Two of our pack ponies were still at the camp so we rode them for nearly a mile, and then the snow and ice began, and the ponies could go no further. It looked a long way to the triangular rock on the skyline which is at the summit

of the pass, and it took us two and a half hours to reach that rock. The path was slippery; the snow had melted a little and become frozen again. I wondered if a yak would have been very much help. We had borrowed some Kashmir grass from Mr. Newman to make grass shoes, so I wore them. They have an extraordinary grip, and I felt quite confident on ice-covered rocks.

The Zanskar range behind us was covered with mist but it cleared somewhat in the evening and we saw the tops of the highest peaks for a few minutes. To the west a snow-capped peak appeared with two glistening glaciers on the face of it. The sun shone on it with a perfectly dazzling brilliance, which showed up the more as we were in shadow.

As we got higher, clouds gathered from every side, and the last few hundred yards meant just pegging on in the face of a snow storm. We could see only about ten yards ahead. Breathing was difficult, and we climbed slowly at the end, stopping every ten paces for breath. We thought if we could find shelter behind a rock at the top it would probably clear, the clouds blow away, and we would get the view we had come so far to see. I was not tired as the air had a certain exhilaration in it, but breathing was not easy.

Major Mason and his party had just managed to get across the week before, and we saw the remains of a poor yak that had fallen by the wayside, not able for its load. The kites had left nothing but the skull and backbone and a leg with a hoof showing a little of its brown hair. It died in harness—a thing to be thought much of in a country where no merciful bullet is allowed to end the sufferings of the cow tribe, however great their pain. I was told that even Bovril is not allowed to be brought into the Hindu state of Kashmir. I had brought a bottle unwittingly. I had not connected it in my mind with beef.

We had a cup of coffee from the thermos half an hour before reaching the top, and had to open a tin of condensed milk as no fresh milk was available so high up as our camp. After that the tin had to be carried level, so there was nothing for it but for me to carry it myself, slung in a napkin. More coffee and sponge cakes at the summit, and R. had his usual hard-boiled eggs.

I had been warned so often about mountain sickness that I was fortunate in feeling no bad effects whatever from the altitude. It seemed natural that we had to stop often to take breath. On reaching the top I peered down on the other side and could just see a winding path for a hundred yards ahead, then snow began to fall and in ten minutes there was an inch of snow, and we had difficulty in finding my gloves and the cork of the thermos which I had placed beside me on the rocks. We had to give up all idea of waiting at the top until the clouds cleared away. The tiffin coolie had carried our two coats, but even when wearing the coats it was very cold. and R.'s topee had half an inch of snow on it.

We had walked downhill for an hour before the storm cleared away.

and there was blue sky overhead and to the north. Luckily for our peace of mind this did not last long. The whole ridge was very soon enveloped in mist again. To the south the clouds broke apart and we saw the green cup of cultivated fields where Leh lies, with the Indus beyond, and further still the Zanskar range, gleaming white in the sunshine. It was like a peep of the land of Canaan after such a morning of storm and clouds.

Kelpie was with us, and although he must have been tired, he hunted marmots the whole way down.

A golden-headed eagle circled round us far up the mountain side, and we did not lose sight of it for at least two hours. There were several new flowers which I had not seen before.

While we were out our servants had moved camp four miles further down the valley to Ganglas, the nearest village to the pass, so that R. could start early next morning on a last search for sharpu.

These last four miles seemed like ten. It is a stony path, and probably the height had affected us more than we knew, as we were both very weary and thankful to get into camp. Our tent was pitched under willows beside the village. There must have been a festival or a wedding that day, as when we arrived there after midday all the women were parading in their best attire. Pheraks and cloaks were very gorgeous. A band of drums and whistles began to play on the roof of the house behind our tents. I would fain have slept all afternoon, but just as I got drowsy the band started again, and sleep would not come. They even played far into the night. We turned in at half-past seven but had rather a disturbed night.

Rain fell for a few minutes next morning, and the tent was quite wet. Dark clouds had gathered up the Indus valley, and thunder rumbled in the distance. It was very unlike the usual weather in Ladakh. R. did not start so early. We had to give the tents about an hour to dry, so Kelpie and I, with a Ladakhi coolie to carry the tiffin basket, started for Leh, four or five miles away. The air was delightfully fresh and clean after the rain, larks were singing lustily. I met women taking their small flocks of goats and sheep up to pastures. I got a great welcome from Garry who had been left behind as he was rather thin. Mrs. Kunick was most kind, bringing me lettuce and fresh butter—both great treats in a country where such things are not available to travellers.

Burra Subhana, the big tiffin coolie, had been sent off two days before with a Ladakhi to Stok. There was just a possibility that the sharpu R. had wounded might be found. It might have kept going for some time before it dropped. We had sent a man from Phayang, but he had gone straight back to Leh, so R. thought it better to send one of our own men.

I asked if Burra Subhana had come back, but there was no word of him.

We slept in the Dak Bungalow as we hoped to move off in two days, and it was easier to pack in a room. It is so tiring in the tent never being able to stand up straight.

R. came back having seen nothing, and Mr. Peter came with some

bowls to show us, and some stone-marten skins that he had got from trappers in the Zanskar. They were not cured, but a very pretty colour and so soft that I could not resist them. Mr. Kunick came up to ask us to dine with them, but I had a nasty bilious headache and R. was tired, so we went off early to bed after a light meal.

Two men came to say that sharpu had been seen on the hills behind the bungalow. R. had not intended to go cut again, and we had planned to have a day free for packing, but on hearing they had been seen so near he thought he would have one more attempt. After I was in bed and R. was looking out field glasses and ammunition for next morning, I heard Burra Subbana's voice, and then Khazir But talking very excitedly on the verandah. R. went out to ask what had happened, and I just heard the word "mila" found. By the light of a candle the head was examined and measured. It measured 31 inches and was a beauty, better than any we had seen or could have hoped for. I sat up in bed and wrote a hurried note to the Padre. He had been so kind in helping that I wanted them to know the good news at once. As we told Mr. Kunick afterwards, if it had not been for them we should never have stayed so long in Leh and so would not have got a sharpu. In a few minutes he himself arrived just as pleased and excited as we were over the good fortune. Two ladies from the Dak Bungalow were dining with them, but he had just run up to say his congratulations in person.

We went off to sleep very happy that night, feeling that all those days of strenuous labour had been of some avail.

(*To be continued.*)

Current Literature.

CUMMINS, S. L., and WILLIAMS, ENID M. **An "Acid-Fast" other than Koch's Bacillus Cultivated from sputum.** *Tubercle.* 1933, v. 15, 49-53.

The organism described in this paper was obtained from the sputum of a young lady suffering from acute pulmonary disease which had come on shortly after a confinement. The clinical, radiological and systemic picture was that of acute phthisis, but the sputum had been reported negative on several occasions. The patient had suffered from the œsophageal condition called by Hurst achalasia of the cardia, and in the course of X-ray examinations in connexion with this a year before the onset of the acute lung disease an opacity had been detected in the right lung. With the sudden onset of acute pulmonary disease she became intensely cachectic, with high hectic temperature accompanied by much cough and sputum and appeared to be in the last stages of "galloping consumption." Blood examination

showed extremely rapid sedimentation of red cells, a bad Arneth count and a marked increase of monocytes as compared with lymphocytes. The sputum was found to contain numerous acid-fast bacilli, for the most part indistinguishable from tubercle bacilli but showing a few curious "balls" of curved rods sufficiently peculiar to raise the question of an unusual morphological type. The organism was markedly acid- and alcohol-fast, homogeneous or nearly so when stained by Ziehl, markedly granular with Much's stain and also ordinary Gram's stain. Morphological differences occurred, depending on age and on the medium, some elements being short, others long and often curved. No sign of branching was noted. Growth was rapid on egg medium, with or without glycerine. Original cultures developed within five to seven days, and subcultures were well advanced in twenty-four hours, being most profuse on media commonly used for tubercle bacilli. Cultures on solid media were at first white or cream coloured, then slightly yellow, and later became markedly corrugated. When exposed to sunlight the cultures developed a marked brownish coloration. The organism was found to emulsify much more readily than the tubercle bacillus.

Guinea-pigs inoculated subcutaneously with doses of about ½ milli-gramme showed no signs of either local or general disturbance. A dose of 1 milligramme led to well-marked inguinal adenitis, persisting for some weeks. Of two animals treated in this way, one died after four months of intercurrent broncho-pneumonia and was found free from tuberculosis. Although cultures were negative acid-fast organisms were seen in sections of lung and inguinal lymphatic glands. The other animal, killed after five months, was completely negative. Nine guinea-pigs inoculated in the left groin all developed well-marked adenitis of the left inguinal glands. From one of them (killed on the tenth day) a positive culture was obtained from the liver. Another was killed and appeared normal except for a slightly enlarged spleen; the cultures were negative. A third showed an abscess in the abdominal muscles in the pus of which numerous acid-fast bacilli were found. The remaining six are still alive. Intravenous inoculation of a rabbit produced a large abscess around the ear vein; cultures from the pus produced a profuse growth of the bacillus. When the rabbit was killed no organic disease, apart from some lymphoid hyperplasia in the lungs and considerable degeneration of hepatic cells, was found and the organs were free from acid-fast bacilli though these were still present in the ear abscesses. Guinea-pigs, pigeons and a rabbit exposed in a closed glass chamber to the inhalation of the bacillus gave negative results.

Intradermal tests were carried out on laboratory animals and on human beings with "tuberculin" made from the bacillus. Positive results were obtained in guinea-pigs infected with the bacillus, while normal guinea-pigs were negative. Results with tuberculous guinea-pigs were inconclusive. Three normal human adults and four tuberculous persons were tested, and

with the exception of one normal and one tuberculous person who gave positives with 0·2 cubic centimetre of 1 in 1,000, the results were negative. The patient from whom the bacillus was isolated declined to be tested.

As other lines of treatment appeared hopeless bronchoscopy was carried out, and some fluid was abstracted and lipiodol introduced. It is believed that the lipiodol may possibly have been responsible for the favourable turn in the course of the illness but this point cannot be definitely settled. The patient ultimately recovered.

The authors believe that the most important conclusion to be drawn from the case is that even when the clinical picture is convincing, the finding of acid-fast bacilli in the sputum is not necessarily proof-positive of tuberculosis and suggest that in all doubtful cases cultural verification should be resorted to. They propose to designate the organism the "M. bacillus."

S. Roodhouse Gloyne.

Reprinted from "Bulletin of Hygiene," Vol. 9, No. 2.

Griffith, A. S. **Observations on the "M" strain of Acid-Fast Bacilli.** *Tubercle.* 1933, v. 15, 53-9.

The author has investigated the pathogenicity of the M. bacillus described in the above abstract. The results of experiments with guinea-pigs were similar to those described by the above authors and showed that the bacillus was not virulent for the guinea-pig and was incapable of producing lesions resembling those of tuberculosis.

Cockerels, about eight weeks' old, were inoculated with a two-day-old subculture. Two of them were given one milligramme intravenously and were killed after 181 and 186 days respectively. No sign of disease was observed post-mortem and cultures were sterile. The cockerel, given a dose of ten milligrammes intramuscularly died after thirteen days from cold and wet. At post-mortem a tough yellowish white necrotic mass $\frac{3}{4} \times \frac{1}{2} \times \frac{1}{3}$ inch was found in the pectoral muscles and smear, from this showed a pure culture of pleomorphic acid-fast organisms. Other smears and cultures were negative. A dose of twenty-five milligrammes intramuscularly caused a thin fibrous patch between pectoral muscles but nothing else. The failure of the strain to produce disseminated lesions or toxic effects in chickens shows that the organism does not belong to the avian group of tubercle bacilli.

Experiments on the rabbit in which a large dose of M. bacilli was injected intravenously showed that the bacilli may become lodged in various tissues and multiply and produce lesions. The seats of election were the synovial membranes of the joints and tendon sheaths and, in one rabbit, the lymphatic vessels of the subcutaneous and subperitoneal tissues. The kidneys showed lesions of a retrogressive nature. The author concludes that the bacillus is pathogenic for the rabbit, but suggests that more

experiments, with smaller doses of bacilli, are necessary in order to determine the degree of pathogenicity.

Five mice inoculated intraperitoneally with M. bacillus died; three which received large doses of 10, 10 and 5 milligrammes, died in two, two and a half and three and a half days respectively. At autopsy in each case there was marked pallidity of the liver, the omentum was rolled up and the mesentery and peritoneum showed foci. Smears from the liver, spleen, peritoneal foci and anterior mediastinal glands showed extremely numerous acid-fast bacilli. Another mouse which received a dose of five milligrammes died in twelve days and showed severe generalized disease, and most of the kidney substance was replaced by purulent foci. Sections showed abscesses in the cortices swarming with bacilli, and masses of bacilli in the tubules. The mouse with a one milligramme dose died in twenty-nine days and showed little disease except in the kidneys, one of which was more than half replaced by abscesses while the other contained one large and one small abscess. The mouse inoculated with ten milligrammes subcutaneously survived and when killed after 126 days showed no definite lesions and cultures from the organs were sterile.

Two frogs were inoculated in the subcutaneous tissue of the right groin with five milligrammes of the culture. One frog died after eleven days and bacilli were disseminated over the body and had evidently undergone abundant multiplication. The other frog was found dead after ninety-five days but there was no naked-eye lesions. The bacilli were much less numerous than in the first frog and the author concludes that the strain is not virulent for frogs.

S. Roodhouse Gloyne.

Reprinted from "Bulletin of Hygiene," Vol. 9, No. 2.

The Efficacy of the Open Method of Burning Sulphur for the Fumigation of Unloaded Ships.[1]

General Conclusions.

The experiments—the conditions of which were severe—show that in fumigation of an empty ship by burning good quality sulphur in trays (in the proportion of three pounds of sulphur per 1,000 cubic feet of space) a lethal concentration of sulphur dioxide is reached and maintained for more than the corresponding lethal period. Places where it is obvious that gas will hardly penetrate must be thoroughly opened up. If an empty ship is properly prepared for fumigating by the opening up of closed spaces, either sulphur dioxide or hydrogen cyanide will prove an efficient fumigant, but

[1] A note by Drs. P. G. Stock and G. W. Monier-Williams (Ministry of Health), Drs. A. B. Page and O. F. Lubatti (Imperial College of Science), and Dr. C. F. White (Medical Officer of Health, Port of London), submitted to the Permanent Committee of the Office International d'Hygiène public, Paris, October, 1933.

if the ship is not properly prepared, neither gas will be completely effective.

It seems clear to us that whilst individual authorities should be left a full discretion as to the particular method they prefer to adopt, all authorities can safely accept the open method of burning sulphur as a practical and efficient means for the fumigation of empty ships in order adequately to meet the requirements of Article 28 of the International Sanitary Convention.

Reprinted from "Bulletin of Hygiene," Vol. 9, No. 2.

Reviews.

A SIXTH VENEREAL DISEASE. By Hugh Stannus, M.D., Ph.D.Lond., F.R.C.P.Lond., M.R.C.S.Eng., D.T.M. & H.Cantab. London: Baillière, Tindall and Cox. 1933. Pp. xii + 270. 9 plates. Price 12s. 6d.

The title of this work may seem somewhat obscure to those unacquainted with venereal treatment. Syphilis, gonorrhœa and soft chancre are the three classical diseases of venereal origin and no others are recognized by the Law or the Services.

A number of other conditions are however of venereal origin. The Americans have described a genital infection due to Vincent's organism and granuloma venereum has also been recorded. The sixth, which is the subject of the present volume, is divided into lymphogranuloma inguinale of the temperate regions and the better-known climatic bubo of the tropics. We need not be unduly confused over this nomenclature for these are really one and the same disease and the classification is purely geographical.

Much has been written of this condition and much still remains obscure. The author has, however, been at pains to consult practically every known authority on the subject and the bibliography to which he refers covers no less than 900 publications.

Whilst infectivity from venereal sources has been clearly established no organisms have been isolated and the disease would appear to be due to a filter-passing virus.

Many forms of treatment are recorded which of course means that so far no real cure has been discovered. Nearly every intravenous type of treatment has been tried from arsenic to antimony, and a number of cases have been exposed to X-rays and radium. In a limited experience one's personal predilection is to aspirate whenever possible on the lines of the ordinary bubo and by so doing one obviates the great length of stay in hospital which a contaminated incision inevitably involves. Should how-

ever the glands fail to break down sufficiently to be aspirated surgical measures are undoubtedly indicated.

In perusing the various forms of treatment which have been tried one is struck with the absence of one which might possibly prove of great value. In the tropics one of Nature's most widespread remedies exists in abundant measure in the form of the sun. The slowly healing soft chancre, often such a problem to cure in these parts of the world, frequently reacts very favourably to the effects of local "sun bathing," at any rate in places as far as 16° north of the equator. It seems therefore somewhat surprising that no reference is made in the extensive literature to what would appear to be a promising and inexpensive form of treatment.

The volume is well written, clearly printed, adequately illustrated and explains many clinical and bacteriological features which were hitherto exceedingly obscure.

One is tempted to ask how many further conditions may be attributed to a venereal origin? In the Army a number of cases of balanitis, scabies and pediculosis are certainly contracted in this way, and are we quite sure that dhobie itch is always due to infection from the much abused dhobie ghat?

This work is of considerable interest to the dermatologist and the tropical practitioner and should prove very helpful as a reference book to those of our profession who are engaged in "maritime" practice.

L. B. C.

AN INTRODUCTION TO THE STUDY OF THE NERVOUS SYSTEM. By E. E. Hewer, D.Sc., and G. M. Sandes, F.R.C.S. Second edition. London: William Heinemann (Medical Books), Ltd. 1933. Pp. xiv + 147. Price 21s. net.

An accurate knowledge of the minute anatomy of the nervous system is essential for the proper understanding of the clinical pictures produced by disease of this system.

The necessary information is difficult to obtain from the ordinary text-books of anatomy, histology and physiology, but in the second edition of Hewer and Sandes' Introduction to the Study of the Nervous System the subject, both from a physiological and anatomical point of view, is dealt with clearly and concisely, and a great wealth of valuable information has been brought together in this one volume. There are numerous diagrams, very clear and easy to follow, illustrating beautifully the substance of the context; from these one can easily trace the connexions between the cord and the brain and the situation and deep connexions of the cranial nerves, a subject of considerable complexity but of the greatest importance in the study of neurological problems.

A short and concise résumé of the work on the cerebrospinal blood-vessels is given, summarizing the important contributions of Stopford and

others in this field. In this edition the chapter on the autonomic nervous system has been considerably enlarged in view of the increased interest of this system to the surgeon.

This volume should prove of great value to graduate students working for higher examinations as well as to those interested in the subject from a purely clinical point of view. A. G. B.

BRUCE AND DILLING'S MATERIA MEDICA AND THERAPEUTICS. An Introduction to the Rational Treatment of Disease. By Walter J. Dilling, M.B., Ch.B.Aberd., Professor of Pharmacology and General Therapeutics, Liverpool University, etc. Fourteenth edition, revised. London : Cassell and Co., Ltd. 1933. Pp. x + 700. Price 10s. 6d.

The fourteenth edition of this popular work will receive a warm welcome from student and practitioner alike. During the seven years that have elapsed since the last edition appeared, there have been considerable changes in opinion on many points; new drugs and treatments have been introduced and several have fallen out of favour. For these reasons and also because of the publication of the British Pharmacopœia in 1932, an unusually great amount of rewriting has been necessary in the preparation of the present edition.

Professor Dilling has been very successful in his task. The book is as interesting to read as it is up to date in its information. Many new drugs and therapeutic methods have been introduced; accounts are given of bulbocarpine, harnine, plasmoquine, atebrin, fouadin, etc., and there is the most recent information upon such subjects as the pituitary, parathyroid and various hormones, vitamins, basal and pre-anæsthetic hypnotics, local anæsthetics and antitoxic sera.

The indexing is complete and accurate.

As a textbook for students and a reference book for those in practice, no better volume than this could be recommended.

AN OUTLINE OF IMMUNITY. By W. W. C. Topley, M.D., F.R.C.P., F.R.S., Professor of Bacteriology and Immunology in the University of London. London: Edward Arnold and Co. 1933. Pp. vii + 415. Price 18s.

This important book is distinguished by the clarity of its writing and the sensible arrangement of its subject matter. It is thoroughly up to date and the senior student or specialist will read it with pleasure, but it is doubtful if the preclinical medical student, unless the system of training is completely altered, would ever have time to appreciate it. The average medical student is not strongly attracted towards any branch of pathology. There are many reasons for this, but a very important one would disappear if Professor Topley would write an outline of General Pathology.

Each chapter of the book ends with a summary and a full list of references to the literature. Finally there is a satisfactory index.

Service medical officers will be disappointed to find no reference to Leishman's work on the active immunization against typhoid fever. Whilst fully acknowledging everything that Wright did in this connection it must not be forgotten that it was owing to the work of Leishman and other officers of the R.A.M.C., that the value of antityphoid vaccine was recognized and appreciated by the whole world. But this is, perhaps, a small point in a book in which nearly every aspect of immunity is considered in so thoughtful and attractive a manner. H. J. B.

ROSE AND CARLESS' MANUAL OF SURGERY. By C. P. G. Wakeley and J. B. Hunter. Fourteenth Edition. London: Baillière, Tindall and Cox. 1933. Pp. vii + 1487. 721 figs., 24 plates (16 coloured). Price 30s.

The fourteenth edition of this well-known textbook shows evidence of having been very carefully revised and brought up to date. Much new matter has been added on such subjects as the radium treatment of malignant disease, the surgery of the sympathetic nervous system and thoracic surgery. Of more general interest will be the description of modern treatment of fractures, and the newer methods of examination of the urinary tract. The chapters on ophthalmic surgery, tropical surgery, gynæcology and anæsthetics have also been thoroughly revised.

The general letterpress and illustrations have been improved by printing the whole book on a surfaced paper, and this has enabled the many excellent skiagrams to be distributed throughout the text instead of being grouped in an appendix.

The chapter on amputations is perhaps not quite so up to date as the rest of the book and does not in the reviewer's opinion give due weight to the views and experience of Roehampton Hospital.

The new edition, which can be obtained for the same price in the form of one or two volumes, can be confidently recommended as a standard textbook of general surgery.

B. B.

MODERN ASPECTS OF GASTRO-ENTEROLOGY. By M. A. Arafa. London: Baillière, Tindall and Cox. 1933. Pp. xviii + 374. Price 27s. 6d.

In a volume of 374 pages the author has set out the conclusions he arrives at from an intensive study of diseases of the digestive system over a period of years, during which he studied this subject in England, Germany and Austria. The result is a book particularly useful to the average medical practitioner who wishes to have available a concise yet exhaustive treatise on gastro-intestinal disorders. The foreword by no less an authority than Hurst is sufficient recommendation, but we would go further than this in expressing our appreciation of Dr. Arafa's work. The opening chapters

are devoted to investigation and stress is rightly laid on the great importance of taking a careful history in all such cases. Gastric analyses are dealt with in detail, but we could wish the author had been able to include more examples from actual cases in this section. The author takes the standpoint that the primary condition in the majority of cases lies between gastritis, ulcer and gall-bladder disease. A full chapter is devoted to each of these, and nothing that has stood the test of clinical experience has been omitted. A large section of the work is devoted to the investigation and diagnosis of intestinal complaints, and we are glad to see colitis dealt with from the point of view of the tropical physician, with some excellent illustrations of sigmoidoscopic findings taken from the original paper published by Biggam and the author.

The volume contains much additional information on the analyses of fæces and the investigation of pancreatic dysfunction.

There is a concluding chapter on diet, giving details of Hurst's ulcer régime.

This book is so good that it seems a pity the author did not include also some account of that very serious gastro-intestinal malady—sprue.

J. H.-S.

Correspondence.

THE POX-DOCTOR'S CLERK.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—Can any of your readers tell me the origin and meaning of the saying, "AS LUCKY AS THE POX-DOCTOR'S CLERK?"

Recently when I was riding home with hounds a farm labourer made this remark to our Master, *à propos* of his having found four foxes in our small withy-bed. The Master did not know whether to take the observation as a compliment or otherwise! I promised him that I would find out what it meant. The saying is apparently not confined to the West of England (where I live). But why should a quack venereal doctor have a clerk? And why should that individual be considered lucky?

Highbury,
Warminster, Wilts.
March, 1934.

I am, etc.
OSKAR TEICHMAN,
Major, late R.A.M.C. (T.A.)

No. 6. June, 1934. Vol. LXII.

Gt. Brit

Journal

OF THE

Royal Army Medical Corps

IN ARDUIS FIDELIS

ISSUED MONTHLY

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Price Two Shillings net

VOL. LXII JUNE, 1934. No. 6.

Journal
of the
Royal Army Medical Corps.

Original Communications.

A CASE OF INFECTION WITH SALMONELLA, TYPE DUBLIN.

By LIEUTENANT-COLONEL R. F. BRIDGES,
Royal Army Medical Corps.

THIS case was of interest on account of the unusual organism that was isolated from the patient's blood and the fact that he was found to be suffering from both benign and malignant tertian malaria at the same time.

The patient, Rana Rai, a cook in the 1/7th Gurkha Rifles, was aged 18, and had nine months' service. He was admitted to hospital at Quetta on August 11, 1933, complaining of headache and "fever" of two days' duration. He gave a history of an attack of malaria one year previously. On examination his temperature was found to be 102° F., the spleen was enlarged and benign tertian parasites were observed in the blood. He was treated with plasmoquine and quinine given by the mouth, but since the temperature did not respond rapidly, an intravenous injection of four grains of quinine was given on August 17. At the same time the blood was taken for culture and yielded a pure growth of a non-lactose-fermenting bacillus.

The temperature fell to normal on August 20, and remained so for some days. On the 27th, however, a second rise in temperature occurred to 103° F., and the patient then complained of pain in the throat and chest. A slight cough was also present. The throat was seen to be congested and the tonsils enlarged, but no physical signs could be found in the

chest. Examination of blood-films now showed the presence of malignant tertian rings and crescents. A second blood-culture proved sterile.

The patient was treated with intravenous injections of quinine and the temperature gradually subsided, reaching normal on September 4. From then onwards the patient made an uninterrupted recovery.

The organism which had been isolated from the blood was a Gram-negative motile bacillus, and gave biochemical reactions of the Salmonella group. It showed no H agglutination when tested with the serums of *Bact. typhosum* and *Bact. paratyphosum* A, B and C. Further tests showed, however, that it was agglutinated by the serum of the *Bact. enteritidis* of Gaertner, but not to the full H titre of the serum. It seemed probable, therefore, that the bacillus was a member of the small family of organisms which have H antigens partially in common with the *Bact. enteritidis* and may be described as the Enteritidis sub-group. The known members of this sub-group, in addition to the *Bact. enteritidis* itself, are types Newcastle, Derby, Dublin, Rostock and Moscow. Further tests were necessary to decide whether the strain Rana Rai could be identified with one of these.

Before detailing the tests that were carried out, it may be of interest to describe shortly the method which has been adopted, both in England and Germany, to express the complicated antigenic relationships existing between the organisms composing the Salmonella group. The method owes its inception to White (1925, 1926) who adopted a system in which the flagellar antigens are represented by letters and the somatic antigens by numerals. By this means antigenic relationships can be recognized at a glance. Thus, if two organisms have antigens which are partially identical, while each has a fraction peculiar to itself, the two antigens may be represented as AB and AC. The system of notation employed by White has been followed by other British workers in the same field whenever organisms belonging to unclassified types have come under examination.

About three years after White published his studies of the Salmonella group and introduced this system of antigenic representation, certain German workers re-examined all known organisms of the group. They evolved a system of notation similar to that of White, but, rather unfortunately as some may think, in representing particular antigenic elements they made use of letters and figures entirely different from those which had been assigned to them by White and others.

In his admirable paper summarizing our knowledge of the Salmonella group, Lovell (1932) has set out the British and German classifications in parallel columns. Examination of these tables shows that there is general agreement in essentials between British and German workers. At the same time one cannot help noticing that the German classification is by far the simpler of the two. Indeed, one feels inclined to suggest that the British classification, although first in the field, should now be discarded

in favour of the German. On the other hand, it is doubtful if this would be really helpful, since there can be no certainty, in the absence of some controlling authority, that individual workers in the two countries would not again diverge along dissimilar paths. Here is a matter in which the League of Nations might interest itself usefully.

In the present instance we are only concerned with the Enteritidis sub-group, in dealing with which we are relieved of much complication, since these organisms exist only in the type phase.[1] In Table I, which has been extracted from Lovell's paper mentioned above, the relationships of these organisms are shown in the British and German classifications.

TABLE I.—THE ENTERITIDIS SUB-GROUP.

Type	German Classification		British Classification	
	O antigen	H antigen	O antigen	H antigen
Newcastle	I III	gs.	?	Specific + R
Derby	IV	gf.	II	RQ
Enteritidis	IX	gom.	III	RP_1P_2
Dublin	IX	gp.	III	RP_1P_3
Rostock	IX	gpu.	—	—
Moscow	IX	goq.	III	$R(P_1+P_2)-P_4$

It will be seen that a factor g in the German classification (R in the British) is common to the flagellar antigens of all the types. This common factor denotes that cross-agglutination will occur between all these types. At the same time, each organism has a portion of its antigen peculiar to itself, and hence no type will react to its full homologous titre of a serum prepared from another type.

In the case of the somatic antigens, the numerals represent only the major antigenic elements present in each type. Many minor factors also exist in their antigens, which may cause some cross-agglutination throughout the whole Salmonella group, but are omitted from our tables. The numerals should, therefore, be regarded as representing antigenic *groups* rather than the total antigenic content of the organisms. It will be noted that four of the organisms, namely, types Enteritidis, Dublin, Rostock and Moscow, all belong to the same group. In other words, their somatic antigens are wholly or mainly identical.

When the strain Rana Rai was received in the laboratory cultures of all types except Rostock were available. Serums, however, had only been prepared from types Enteritidis and Derby. Agglutination and absorption tests were carried out with these two serums, and the results are shown in Tables II and III.

[1] With the exception of the Tokyo type, which was originally described by White (1929) as a diphasic *Bact. enteritidis*, but it is now understood to have completely lost its group phase.

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TABLE II.—AGGLUTINATION TESTS.

Serum	Nature of test	Organism agglutinated					
		Newcastle	Derby	Enteritidis	Dublin	Moscow	Rana Rai
Enteritidis	H	225	250	2,000	350	550	250
	O	Nil	250	1,000	800	1,000	800
Derby	H	700	1,750	550	500	350	600
	O	17	700	17	35	17	17

TABLE III.—ABSORPTION TESTS.

Serum	Nature of test	Homologous titre	Homologous titre after absorption with Rana Rai
Enteritidis	H	2,000	1,100
	O	1,000	Nil
Derby	H	1,750	350
	O	700	500

NOTE.—Formalized broth cultures were used for H agglutination tests and the serums were diluted to have homologous titres of about 2,000. Alcoholized suspensions were prepared for O tests aud the serums were used at full strength. In all absorption tests a control test was set up to ensure complete removal of agglutinin for the absorbing agent. Nil = no agglutination in 1 : 25 dilution.

It will be seen that neither the Enteritidis nor Derby serum could agglutinate strain Rana Rai to full H titre. The O agglutination tests showed that the somatic antigen of strain Rana Rai probably belonged to the same antigenic group as that of type Enteritidis, and that it differed markedly from those of types Newcastle and Derby. Absorption tests showed that strain Rana Rai could not remove the homologous H agglutinin from either serum, and they confirmed the impression that the somatic antigens of strain Rana Rai and the *Bact. enteritidis* were identical.

It was evident, therefore, that strain Rana Rai could not be identified with types Enteritidis, Derby or Newcastle. It thus becomes necessary to prepare serums from the remaining available types, Dublin and Moscow, and from strain Rana Rai itself. When these serums had been obtained, cross-agglutination and absorption tests of the H and O antigens were carried out as before. The results are shown in Tables IV and V.

It will be seen that type Dublin and strain Rana Rai cross-agglutinated one another to full H titre, and that in absorption tests each organism removed the whole of the H and O agglutinins from the serum of the other. Serological identification of strain Rana Rai as a representative of the Dublin type of Salmonella was therefore complete.

TABLE IV.—AGGLUTINATION TESTS.

Serums	Nature of test	Organism agglutinated		
		Moscow	Dublin	Rana Rai
Moscow	H	2,250	700	700
	O	500	300	350
Dublin	H	1,000	2,500	2,500
	O	350	275	350
Rana Rai	H	1,000	2,000	2,000
	O	2,250	1,400	2,000

TABLE V.—ABSORPTION TESTS.

Serum	Nature of test	Homologous titre	Homologous titre after absorption with:—		
			Moscow	Dublin	Rana Rai
Moscow	H	2,250	Nil	1,100	1,100
	O	500	Nil	Nil	Nil
Dublin	H	2,500	800	Nil	Nil
	O	275	Nil	Nil	Nil
Rana Rai	H	2,000	300	Nil	Nil
	O	2,000	Nil	Nil	Nil

Confirmatory evidence as to the nature of the strain was afforded by certain biochemical reactions. Smith and Scott (1929) have shown that a distinguishing characteristic of the Dublin type is its inability to ferment, or its late fermentation of, arabinose and rhamnose, whereas the remaining members of the Enteritidis family attack these carbohydrates regularly within twenty-four hours. It was found that strain Rana Rai conformed to this description.

Tests carried out with the patient's serum during and after his illness gave no clue to the nature of the infection. At no time did the serum contain H agglutinins for any member of the Salmonella group, in spite of previous inoculation. The serum, however, agglutinated O suspensions of the homologous strain and of the *Bact. typhosum* to a titre of 1 : 250. This is explained by the fact that the *Bact. typhosum* belongs to the same somatic antigenic group as the Dublin type. Since the power to confer immunity is said to reside in the somatic antigen, one may note, in passing, that the ordinary T.A.B. vaccine should be protective against infection with the Dublin organism.

The Dublin type is of infrequent occurrence. So far as is known, it has never previously been isolated, or at least recognized, in India. It was

originally described and named by White (1929), who found that an organism isolated in Dublin from a fatal case of fever was identical with a strain which had been recovered some years previously from a child suffering from meningitis. He found that these strains were related to the *Bact. enteritidis*, but differed from it in the detail of their serology. Smith and Scott (1929) described three cases of continued fever occurring in Aberdeen, in which the Dublin type was isolated from the blood. At the same time, they examined twelve other stains, of which six had been derived from cases of calf dysentery in Denmark and two from human cases of food poisoning. They believe that the Dublin type is specially associated with the bovine species, and that milk is the usual source of human infection.

I am indebted to Lieutenant-Colonel S. G. S. Haughton, O.B.E, I.M.S., Commanding Indian Military Hospital, Quetta, for the clinical notes on the case; and to Lieutenant-Colonel D. T. M. Large, R.A.M.C., by whom the organism was isolated, for the serological results during the patient's illness.

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BLOOD TELLURITE AGAR AS A SELECTIVE MEDIUM FOR *CORYNEBACTERIUM DIPHTHERIÆ*.[1]

By Major F. G. A. SMYTH,

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The object of the investigation described below was to find a method of obtaining a pure culture of *C. diphtheriæ* from a throat swab which would be expeditious and suitable for use in military laboratories in India.

It is essential to obtain such a pure culture before satisfactory virulence tests can be carried out in animals, and it is definitely desirable that such virulence tests on all strains of *C. diphtheriæ* grown from the throats of patients and contacts who do not show the clinical signs of diphtheria, should be carried out and reported on with the least possible delay. Every day of unnecessary isolation of soldiers harbouring avirulent strains is a loss to the State and a nuisance to all concerned.

The original throat swab is usually cultured on Loeffler's medium on which *C. diphtheriæ* grows well in eighteen hours. But in many cases it is not possible to pick off a single colony of *C. diphtheriæ* from the mixed growth on the Loeffler's slope and the need arises for a selective medium on which an emulsion of this growth can be plated.

To be generally applicable to military laboratories in India such a medium should: (i) Be easily and rapidly prepared as occasion arises; (ii) inhibit the concomitant organisms of the human throat; (iii) produce recognizable colonies of *C. diphtheriæ* in twenty-four to forty-eight hours; (iv) be inexpensive.

Many selective media for *C. diphtheriæ* have been described. Probably the most widely used are Douglas's medium [1], or Allison and Ayling's modification of it [2]. But these media, excellent as they are, take time to prepare and can only be used in laboratories equipped with the apparatus for sterilizing serum by filtration. In the case of Allison and Ayling's medium some workers find that batches of this medium vary in their inhibitory powers, some proving inhibitive to *C. diphtheriæ* itself.

In October, 1932, Horgan and Marshall [3] published a description of a blood tellurite agar medium which promised to fulfil the requirements tabulated above. It was decided to give this medium an extensive trial and it may be said at once that, although all the claims of Horgan and Marshall on its behalf have not been verified, it has proved to be a most useful medium and quite suitable for general use in military laboratories in India.

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[1] This paper was written in India in July, 1933, and received for publication on January 8, 1934.

Preparation.

Horgan and Marshall recommend its preparation as follows : (i) Ordinary nutrient agar two per cent at pH 7·6 ; (ii) ox blood (citrated one per cent approx.) ; (iii) Pot. tellurite (B.D.H.) two per cent in distilled water. To fifteen cubic centimetres of the agar at 50° C. add 1·5 cubic centimetres of (ii) and (iii), mix and pour plates ; or mix equal parts of (ii) and (iii) and store in a refrigerator up to twenty-one days, then add three cubic centimetres of this mixture to fifteen cubic centimetres nutrient agar as required.

The first method is the one best suited to military laboratories in India as the lack of a suitable refrigerator precludes the use of the second. It has been found, however, that the blood tellurite mixture will keep for about a week at room temperature (summer in the hills, winter in the plains). After that interval moulds and bacteria tend to develop in it, with the result that plates made from it are contaminated and apt to liquefy.

To revert to the first method of preparation, when occasion arises blood can be drawn at the local slaughter house any morning and mixed with stock potassium tellurite solution and nutrient agar and poured into plates. After a few hours drying the plates can be used the same day so that there is no need to keep a stock of media always ready in case a positive throat swab arrives, an event which may only occur at long intervals.

Three cubic centimetres of blood tellurite mixture to 15 cubic centimetres nutrient agar corresponds to 20 cubic centimetres of the mixture to 100 cubic centimetres agar. Proportions varying between 13 and 20 cubic centimetres of the blood tellurite mixture to 100 cubic centimetres agar have been tried and there is very little difference in the results obtained between these limits. The plates of media containing relatively less blood are more transparent and so better for examining colonies by transmitted light, but the colonies are apt to be smaller on the weaker mixtures. On the whole the proportions originally recommended by Horgan and Marshall are as good as any.

Instead of ordinary nutrient agar, digest agar made with Hartley's broth has been used in most cases, as this is the routine medium in our laboratory. A comparison made between plates made with nutrient (lemco) agar and digest agar was all in favour of the latter, both as regards the rate of growth and freedom from contaminations.

A small practical point—it has been found that better results are obtained if the blood tellurite mixture is added to agar at 55° C. instead of at 50° C.

Inhibitory Powers.

Horgan and Marshall stated that a concentration of pot. tellurite of 0·16 per cent (the final concentration in their medium) was totally inhibitive to staphylococci and streptococci after twenty-four hours' growth. This has not been verified. The inhibitory powers of pot. tellurite at higher dilutions have been worked out by Fleming [4], and it has been found

during the course of the present investigation that even at a concentration of 1 to 625 (i.e. 0·16 per cent) the organisms which Fleming recognized as inhibited by pot. tellurite, viz., streptococci and staphylococci, still survive. Streptococci and staphylococci have grown occasionally on plates of Horgan and Marshall's medium, but not with any regularity. Actual figures show that out of forty-five mixed cultures of *C. diphtheriæ* and other organisms plated on blood tellurite agar, streptococci and/or staphylococci grew in seventeen cases; in the remainder *C. diphtheriæ* and *C. hofmanni* alone developed.

Attempts to correlate the appearance of these other organisms with variations in the strength and preparation of the medium have failed. Growth appears to depend on the powers of resistance of certain strains; certain streptococci and staphylococci originally isolated from blood tellurite agar plates have been kept alive in the laboratory and still show ability to develop on any batch of this medium on which they are inoculated.

At the same time, it must be emphasized that this medium has definite, if incomplete, inhibitory powers on the majority of organisms outside the corynebacteria which inhabit the human throat, and its lack of complete inhibitory powers is not sufficient to preclude its use in an intelligent manner.

Dust-borne moulds grow well on blood tellurite agar, also yeasts which are fairly common in throat swabs. Care must therefore be taken not to expose plates to the air more than possible.

Recognition and Rate of Growth of *C. diphtheriæ*.

Horgan and Marshall describe two types of colony of *C. diphtheriæ* as follows:—

	24 *hours*	48 *hours*
(i)	Small greyish, flat, rather translucent.	Larger, black, with grey halo.
(ii)	Small, grey, slightly opaque, with black granular centre.	Slightly larger, grey, with black granular centre and wider grey halo.

Both these types have been met with, and soon become easily recognizable to anyone using this medium. At the same time a third type has been noticed on several plates, namely, a small jet-black opaque, smooth, highly polished, dome-shaped colony with no halo. After forty-eight hours this colony has increased in size without any other change in appearance, and after three or four days' growth it sometimes develops an umbilicated central nodule.

The rate of growth of *C. diphtheriæ* on blood tellurite agar is variable, but with a little practice typical colonies may be recognized, with the aid of a lens, after twenty-four hours in the great majority of cases. In all cases, they are distinguishable after forty-eight hours' incubation.

C. hofmanni is the only other organism growing on this medium that is likely to be confused with *C. diphtheriæ* by its colonial appearance. It may

grow as a large, dull, pearly-grey umbonate colony which is quite readily distinguishable. On the other hand it may form small, jet-black convex colonies very like the black colonies of *C. diphtheriæ* described above. Distinguishing points are that the colonies of *C. hofmanni* are flatter, not so regularly dome-shaped, and not so highly polished in appearance as those of *C. diphtheriæ*. But until these points become familiar by practice, resort must be made to staining films of suspicious colonies before subculturing. It is best not to use Neisser's stain for this, as polar bodies do not develop well in *C. diphtheriæ* on this medium; but in a film stained by Gram, *C. diphtheriæ* can be readily distinguished from *C. hofmanni* by its larger size, pleomorphism and characteristic pattern.

Of the other organisms which may appear on plates of blood tellurite agar, streptococci and staphylococci form round, smooth, dark colonies, which may be confusing at first. But on close inspection in a good light, it will be noticed that colonies of these organisms are not really black, but a dark chocolate colour. Only grey or really jet-black colonies need be considered in searching for *C. diphtheriæ* and if a grey halo is present, it is practically diagnostic. Moulds and contaminating sporing organisms form large spreading colonies which soon become easily recognizable.

Cost of Medium.

Potassium tellurite costs about 10 annas a gramme in India, including postage. About two cubic centimetres of a two per cent solution are used in making one plate of medium. Ox blood costs nothing in the ordinary station and the price of agar need not be considered in estimating the extra expense, which therefore amounts to about 5 pies per plate for the potassium tellurite. This is not beyond the means of a district or brigade laboratory.

Method of Use.

It is not recommended that as a routine, throat swabs should be plated direct on blood tellurite agar, as typical colonies may not be evident for forty-eight hours, and much time may be wasted in examining suspicious colonies microscopically.

The ordinary method of inoculating a Loeffler's slope with the original swab enables the bacteriologist to decide in the shortest possible time whether *C. diphtheriæ* is present.

Having confirmed its presence in a growth on a Loeffler's slope, it is not recommended that the whole growth be washed down and the emulsion plated out on blood tellurite agar. A hand lens should be employed to look for typical colonies of *C. diphtheriæ* on the margins of the slope. If seen, a few of these should be picked off and emulsified in sterile saline or broth; three or four loopfuls of the emulsion should then be spread on a blood tellurite plate. This limits the number of contaminating colonies and makes the recognition of typical colonies much easier next day.

If typical and discrete colonies of *C. diphtheriæ* cannot be distinguished

on the Loeffler's slope, it is usually possible to distinguish some portion of the growth where *C. diphtheriæ* is predominant by the raised appearance of the growth. This area should be marked with a grease pencil on the glass, and a film, made by touching it with the end of a straight needle, should be stained and examined microscopically. If *C. diphtheriæ* is numerous in the film, a small portion of this part of the growth should be emulsified and plated as above.

If no portion of the growth is recognizable as containing colonies of *C. diphtheriæ*, the only thing to do is to divide the slope into numbered areas or bands by means of grease pencil lines on the glass, and to examine stained microscopic films from each, and select for emulsion and plating that portion of the growth in which *C. diphtheriæ* appears most numerous.

By using this method of selected, instead of whole, emulsions from the Loeffler's slope, a pure culture of *C. diphtheriæ* will be found on the blood tellurite agar plate in quite a high proportion of cases. In our laboratory the proportion has worked out at sixty-two per cent.

By the method outlined above, the bacteriologist should be able to issue his report on the virulence of a strain of *C. diphtheriæ* in four to seven days after receipt of the original swab.

On Monday, say, the swab is received and cultured on Loeffler's medium. On Tuesday the presence of *C. diphtheriæ* is confirmed and a selected emulsion is plated on blood tellurite agar. On Wednesday a single colony may be subcultured to Loeffler's medium or serum agar, and on Thursday an emulsion of this subculture, confirmed as pure by microscopic examination, is injected intradermally into a guinea-pig. In many cases a definite report on the virulence of the organism can be issued on the Friday. Delay may occur as follows : (1) The preparation of the blood tellurite agar may take twenty-four hours should there be any delay in obtaining blood. (2) Growth on blood tellurite media may take forty-eight instead of twenty-four hours. (3) The reaction in the guinea-pig's skin may not be clearly determinable for forty-eight hours. But a week should be the outside interval between the reports as to the presence and the virulence of *C. diphtheriæ*.

Apart from numerous implantations on blood tellurite agar of various stock organisms made with a view to studying their colonial appearance, detailed records have been kept of the results obtained with 65 mixed cultures from Loeffler's slopes, many of which have been furnished by brother pathologists in India. From these 65 mixed cultures *C. diphtheriæ* grew out and it was recovered in pure culture from blood tellurite plates in 45 cases. It was not so recovered in 20 cases.

The proportion of negative results appears high at first sight, but a study of these in detail shows that :—

(i) In three cases the medium was made from an old contaminated mixture of ox blood and tellurite, and rapidly liquefied.

(ii) In eight cases the Loeffler's slope, after several days in the post

during the hot weather, arrived in a digested and liquefied state, the organism responsible for this being an anthracoid bacillus in each case, which had apparently killed off the *C. diphtheriæ*.

This leaves nine failures in the series in which a reasonable hope existed of getting a pure culture by the method described.

These nine all occurred in the early days of the work before selected emulsions were being used, four of them being from the same case, an R.A.M.C. orderly, who eventually proved to be a virulent carrier and whose throat also harboured a most hardy streptococcus, which grew luxuriantly on blood tellurite agar.

Of the forty-five cases in which *C. diphtheriæ* was recovered from the plates in pure culture, records show that the intervals between plating out the mixed culture and injecting a guinea-pig with a pure culture were as follows: Five days in 2 cases; four days in 6 cases; three days in 22 cases; two days in 15 cases.

This means that the virulence test can be performed forty-eight hours after the first finding of *C. diphtheriæ* in 33 per cent. of cases, and seventy-two hours after in 50 per cent. of cases.

Conclusions.

(1) Horgan and Marshall's blood tellurite agar medium is of great value in isolating *C. diphtheriæ* in pure culture from mixed throat-swab cultures.

(2) It is suitable in every respect for use in Military Laboratories in India.

(3) By its use in an intelligent manner the report on the virulence of a strain of *C. diphtheriæ* should follow the report of its presence after an interval of from three to six days.

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[1] *Brit. Journ. Exper. Path.*, 1922, iii, 263.
[2] *Journ. Path. and Bact.*, 1929, xxxii, 299.
[3] *Journ. Hyg.*, 1932, xxxii, 544.
[4] *Journ. Path. and Bact.*, 1932, xxxv, 831.

THE OUT-PATIENT TREATMENT OF MINOR RECTAL CONDITIONS IN MILITARY PRACTICE.

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During the last few years, there has been a tendency in civil practice towards an increase in the out-patient treatment of minor conditions of the rectum and anus. Conditions such as thrombosed external piles and anal polypi have not for many years been considered serious enough to merit hospitalization ; but it is only since the improvement in the methods of injection treatment that the majority of cases of internal hæmorrhoids and anal fissure have been included in the same category.

The methods described in this article have no claim to originality, but are based on the successful results of recent rectal practice. The object of the article is to emphasize the advantages of employing these methods in military practice, and to draw attention to a type of treatment which is, perhaps, not so widely recognized as its merits deserve.

The following figures comprise a summary and analysis of all the cases of hæmorrhoids and fissure treated in the Rectal Clinic at Queen Alexandra Military Hospital between June 1, 1932, and June 1, 1933.

	Hæmorrhoids	Fissure
Total number of cases sent to the Clinic ..	60	10
Cases considered unsuitable for injection treatment	7	3
Total number of attendances in non-recurrent cases*	317	*32
Average number attendances per patient in non-recurrent cases	5·98	3·2
Cases cured without any sign of recurrence up to date	48	10
Cases not cured and proceeding to operation ..	Nil	Nil
Cases showing recurrence within a year of completion of course	8	Nil
Percentage of recurrence within a year ..	15·09	Nil

* These attendances include 2 per patient for observation after completion of course of treatment.

Selection of Cases.

It has been found that over 80 per cent. of the cases of internal hæmorrhoids sent to hospital for treatment are suitable for injection. The actual selection of cases is largely a matter of experience, but there are certain definite factors which enable one to form an opinion on this

point. In the case of anal fissure, acute cases would appear to react better to local treatment than chronic ones.

(*A*) *Internal Hæmorrhoids. Cases which are not suitable.*

(1) Acutely inflamed or thrombosed piles. These cases should be treated by palliative methods until they have settled down.

(2) Prolapsed piles should never be injected while outside the sphincter—they must always be replaced manually before commencing treatment. If inflamed, they do not come into the category of cases suitable for any form of out-patient treatment.

(3) Internal piles showing chronic fibrous change (the only type of pile which can be felt with the finger on rectal examination).

(4) Internal piles with co-existent conditions such as thrombosed external piles, anal fissure, or fistula-in-ano. In such cases the co-existent condition must be dealt with as a primary measure.

(5) Cases of prolapse of rectal mucous membrane accompanied by engorgement of the submucous venous plexus. This type of case may on superficial examination strongly resemble internal piles.

(6) Proctitis of any severity. It must be noted that a mild degree of proctitis is usually present for about fourteen days following an injection, but is not a contra-indication to the continuance of treatment.

(7) Piles due to some extrinsic cause such as: (*a*) Extramural pressure, e.g. enlarged prostate or pelvic tumour. (*b*) Intramural pressure, e.g. carcinoma of colon or rectum. (*c*) Vascular disturbance, e.g. heart disease, cirrhosis of the liver.

In these conditions permanent relief cannot be expected, but in some of them palliative injections are not necessarily contra-indicated.

(*B*) *Anal Fissure. Cases which are not suitable.*

(1) Long standing fissures showing chronic inflammatory change.

(2) Cases with co-existent inflammatory conditions, such as fistula-in-ano.

End-results of Treatment.

Provided that cases are suitably selected, the end-results are in every way as satisfactory as those attained by operative means. In the case of hæmorrhoids the patient generally experiences complete relief from all symptoms after his first injection. It is a common experience for a patient to be so impressed by the results of his first treatment that he is inclined to doubt the necessity for further attendance. It cannot be too strongly urged, however, that a full course be insisted on in every case, as ultimate recurrence is certain if this rule is broken. It is well known that hæmorrhoids will sometimes recur after careful operative treatment. The recurrence rate following a course of injection treatment cannot be accurately estimated at the present time, but the general impression is that it is somewhat higher than that after operation. However, it is considered

that the relative simplicity and other advantages of the injection method outweigh any disadvantages arising from this fact.

In the case of anal fissure the results are no less striking, and it has been found that in the majority of suitable cases a single injection suffices to produce a permanent cure.

Equipment Required.

(*a*) A suitable table or couch for examination of the patient in the knee-elbow position.

(*b*) A table for instruments.

(*c*) Proctoscope. A slightly cone-shaped tubular pattern with an obturator, and fitted with a handle, has been found to be the most convenient. It is essential that the tube be long enough to reach above the pile-bearing area, and of large enough diameter to allow manipulation of the syringe. A good deal depends on the choice of a suitable type of instrument. We have found that the Lockhart-Mummery pattern fulfils these requirements adequately.

(*d*) Hæmorrhoidal syringe. Here again a suitable instrument is essential. A ten-cubic-centimetre syringe of Gabriel's pattern is recommended. This is fitted with a bayonet catch to which the needle can be securely attached. Three needles are provided; two straight (of different lengths), and one with an angled extremity. The points are guarded by a shoulder to prevent inadvertent penetration of the bowel wall beyond the submucosa.

(*e*) Syringe for injection of anal fissure. An ordinary ten-cubic-centimetre Record is suitable. It should be fitted with an intravenous needle of fairly fine gauge.

(*f*) Head lamp. Any "direct illumination" head lamp will do, but we have found the "Ever-ready motorists inspection lamp" both cheap and satisfactory.

(*g*) Solutions (1) for hæmorrhoids:

℞	Phenol	5 per cent.
	Ol amygdalæ	95 ,, ,,
	Menthol	4 grs. to 1 oz.

(2) for fissures:

℞ Inj. A.B.A. in 5 cc. ampoules. (Burroughs Welcome.)

This solution is made up from anæsthesin 3 per cent, benzyl alcohol 5 per cent, ether 10 per cent in olive oil.

(*h*) Finger stalls, lubricant, gauze swabs, wooden probes with wool mounted on the end, tinc. iodi. mitis.

(*i*) Case filing system.

Examination of the Patient.

In every case a careful history and a routine examination are essential and will often assist materially in the diagnosis of the case. The patient

is then placed in the knee-elbow position, and inspection of the peri-anal region, followed by digital examination of the anal canal and rectum, should be performed. If this rule is adhered to, much information will be gained that might otherwise escape notice, and a number of cases will be excluded without any further examination. An undue amount of spasm of the sphincter accompanied by pain, will give rise to the suspicion of the presence of a fissure, even if the latter cannot be seen or felt. Having excluded the presence of a fissure the next step is proctoscopy. If the proctoscope is warmed, lubricated, and inserted slowly, it causes no pain and only slight discomfort. It should be inserted to its fullest extent under direct illumination of the headlamp. When the obturator is withdrawn a view of the rectum above the pile-bearing area is obtained. The proctoscope is then withdrawn slowly and the remainder of the canal closely inspected. When piles are present they will be seen to prolapse into its lumen, especially if the margin of the distal aperture is pressed against the mucous membrane below the piles.

This examination will also reveal the condition of the mucous membrane of the lower part of the rectum and anal canal.

Technique of Injection for Internal Hæmorrhoids.

During the above examination a mental note should be made of the position of the piles observed. The proctoscope is then reinserted to the upper limit of the piles and any fæcal contamination carefully wiped away with wool swabs mounted on wooden probes. The mucous membrane at the proposed site of injection is then swabbed with iodine in a similar manner. Except in cases in which the piles have been intermittently prolapsed over a long period, it will be found that the area above the pectinate line (i.e. the mucous membrane covering the piles) is insensitive. The position of the proctoscope is carefully maintained, while the attendant hands to the operator the syringe charged with phenol solution and fitted with a suitable needle. Under direct vision the needle point is inserted beneath the mucous membrane immediately above the pile, and the solution injected. When the correct amount has been injected, the mucous membrane covering the bulge produced becomes pearly-white in colour and the small vessels running over it appear as a network of fine red threads. The amount of oil required to reach this tension varies with each individual pile, and may be from one to eight cubic centimetres. It is highly important to stop injecting the oil when the correct degree of tension has been reached —if this is not done the excessive tension will produce sloughing of the overlying mucous membrane, with the possible formation of fistula-in-ano or anal fissure. The same result is produced by intramucous instead of submucous injection. On account of the insensitivity of the mucous membrane, no pain will be produced, but an indefinite sensation of "weight" or "fullness" may be noticed in this situation and usually persists for some twenty-four hours. If the injection is properly performed

there will be no bleeding and very little leakage of the solution after withdrawing the needle.

All the piles present should be dealt with in a similar manner, the obturator then being replaced and the proctoscope removed. Since these injections are always followed by a mild degree of local inflammation, it is well to insist that the patient takes some form of intestinal lubricant (such as liquid paraffin) daily, even if he is not usually constipated. This aperient must be continued during the whole course of treatment and for some weeks afterwards. The patient should attend after a week's interval for a further injection, when it will be found that the areas of mucous membrane have become firm and "leathery" to the touch, and that the piles have shrunk considerably in size. Further injections are then given in the same manner into the mucous membrane below these areas. Injections are repeated at weekly intervals until the whole extent of each pile has become hardened in a similar way; this usually necessitates a course of from four to five attendances. The patient is then discharged and is told to report again in two months' time so that residual piles, if any, can be dealt with and the end-result studied and recorded.

The rationale of this method of treatment depends on the immediate occlusion of the vein forming the hæmorrhoid by the pressure of the fluid superficial to it. This is followed by spontaneous thrombosis which still further destroys its lumen. Owing to the slow rate of absorption of the oil the pressure on the vein is maintained for some days, and by the time that absorption is complete the irritant action of the injected fluid has produced a perivenous fibrosis, thus completing the obliteration of the pile mass.

Technique of Injection for Anal Fissure.

The diagnosis of fissure having been made, and any contra-indications excluded, the perianal skin is carefully cleansed with methylated spirit. The left forefinger is inserted into the rectum, and the syringe containing the A.B.A. (previously warmed by placing the ampoule in hot water) is handed to the operator. The skin is punctured half an inch external to the base of the fissure, and through this puncture the sphincter on either side of the fissure is infiltrated with the solution. About two-thirds of the total amount is used in this infiltration, and the remainder is injected directly beneath the fissure itself. The total quantity of A.B.A. used for this injection in any given case may vary between three and eight cubic centimetres, depending on the amount of sphincteric spasm and the physique of the patient. The injection causes some pain, which does not persist for more than twenty-four hours. The spasm of the sphincter and pain completely disappear after this period if the correct amount has been injected. Muscular relaxation persists for at least three weeks, by the end of which time the fissure will have healed. The patient should be instructed to report again a month after the injection to check the result. Very occasionally a second

injection may be required to complete the cure. The administration of regular doses of intestinal lubricant should be carried out as a routine measure, just as in the case of hæmorrhoids.

Complications Following Treatment.

Serious complications following the injection treatment of hæmorrhoids and fissure are almost unknown. Minor constitutional disturbances very occasionally follow the injection for piles, but do not persist for more than twenty-four hours. These are: slight pyrexia, giddiness, and occasional nausea. The introduction of menthol into the solution tends to minimize these effects, as well as acting as a local anæsthetic. A few patients have noticed a mild degree of perianal irritation following a course of hæmorrhoid injections, but this has easily yielded to local applications of lotio plumbi cum opio.

Case Recording.

It has been found convenient to keep records by means of a simple card index system. The sites of injection are recorded by the "clock" system at each attendance, as is shown in the specimen card below.

12345 Pte. X. 2/Blankshire Regt. Age 28.	
1.1.33	*History* .... *Routine exam.* No contra-indication to injection. *Diagnosis.* Internal piles at 3, 6, and 9 o'clock. *Treatment commenced.* Injection—3 c.c. at 3 o'clock. ,, 2 c.c. at 6 o'clock. ,, 3 c.c. at 9 o'clock.
8.1.33	Complete relief. Sites of previous injection show satisfactory result. Injection—3 c.c. at 3, 6, and 9 o'clock.
15.1.33	Progress satisfactory. Injection—2 c.c. at 3, 6, and 9 o'clock.
22.1.33	Practically complete sclerosis. Injection—2 c.c. at 6 and 9 o'clock.
29.1.33	Patient comfortable. No symptoms. No further injections required. To report in two months' time for observation.
24.3.33	No sign of recurrence. Condition cured.

Conclusion.

For the purpose of dealing with this type of case, a fully equipped hospital is not essential. The treatment can be carried out at any centre which is provided with the few instruments required. The degree of manual dexterity required can readily be obtained by practice, and the experience necessary for the best results will soon be attained. In many cases it would

be found convenient to combine this treatment with the injection treatment of varicose veins, in an Out-Patient Clinic.

The advantages of this type of treatment are obvious. The patient is not subjected to the unpleasantness of an operation, nor to the discomfort following it. He usually experiences an immediate relief from his symptoms, and is not prevented from carrying on his normal routine to any appreciable extent. The period of absence from duty is almost negligible as most cases go back to full duty within twenty-four hours. A considerable decrease in the number of admissions to hospital is effected, with consequent saving of beds. Moreover, the actual cost of this out-patient treatment must obviously be less than treatment involving hospitalization.

We would like to thank Colonel Wallace Benson, Officer Commanding Queen Alexandra Military Hospital, for his permission to make use of the material which has formed the subject matter of this article.

PERSONAL EXPERIENCES IN THE DIAGNOSIS AND TREATMENT OF CONDITIONS APPARENTLY OF TUBERCULAR ORIGIN.[1]

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WITH SOME REMARKS

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Mortality from tuberculosis is rapidly decreasing. Morbidity from this cause is still, however, high. One cannot but be impressed by the number of applicants for life insurance who have a history of T.B. confirmed or suspected. Insurance companies, probably rightly, rely greatly upon mortality statistics for their ratings: hence they are alive to the possibility of T.B. in young applicants of light weight, with a bad family history. They are prone to treat applicants of older ages comparatively leniently. Statistics, however, from their very nature, cannot be up to date, and their source is sometimes open to question. Even physical signs are not very reliable, for, as Dr. Brady points out, signs resembling T.B. can be produced by other organisms besides T.B. To make a really accurate prognosis we require a skiagraphic report and a tuberculin test in all cases of doubt. It is probably impracticable for insurance companies to obtain these data, but without them liens or ratings will often be placed on some of the younger lives which should be taken as standard, and many older lives will be accepted as standard which should be liened or rated.

Though a thorough examination may not be practicable from a life insurance standpoint, in private and hospital practice we are on a different footing, for here we have ample time and means for making a satisfactory diagnosis. A diagnosis of tuberculosis in the early or easily curable stage can only be made by having recourse to the tuberculin reaction, skiagraphy and a record of symptoms. If we wait till we are able to make our diagnosis by physical signs we are making that diagnosis too late. If we wait till T.B. appears in the sputum we are very much too late.

To take up these three aids to diagnosis, viz., the tuberculin test, skiagraphy and a study of the symptoms in order:—

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[1] Reprinted by permission from the *Post-Graduate Medical Journal*, June, 1933.

The Tuberculin Test.

I do not propose to discuss the merits of the various tuberculin tests, for they all appear to give similar information. They all furnish very accurate data as to hypersensitiveness or not to tuberculin, and so are an indication as to dosage in tuberculin therapy. To a lesser extent they give some indication as to activity. At Margaret Street we use the modified Von Pirquet test which was introduced into this country by Dr. H. A. Ellis [1]. It is very simple and is sufficiently accurate for practical purposes.

In order to obtain some data on the value of this test as to activity, I made some observations on officers attending Margaret Street Hospital [2]. I first examined the case sheets of fifty-eight officers who had tubercle bacilli in the sputum and who were, therefore, presumed to be actually tubercular. They all reacted to 1 : 500 or to 1 : 100 dilutions. I next took the cases of 209 officers in whom the sputum was negative to T.B.; of those who reacted to 1 : 500, 84 per cent had clinical or radiographic evidence of activity; of those who reacted to 1 : 100 but not to 1 : 500, 64 per cent showed activity; of those who reacted to 1 : 10 only, and not to higher dilutions, less than 1 per cent showed any evidence of activity. I have since had ample opportunity of confirming these findings, and I am convinced that a modified Von Pirquet which gives reactions with dilutions of 1 : 100 or higher is an indication that there is a probability of an active tubercular focus somewhere. It is often argued that as most of us at one time have been infected with T.B., the majority of adults will react to tuberculin. In my experience this is not the case, provided the test is only trusted in the higher dilutions and provided there be other evidence of the patient being tubercular. To say a man is tubercular because he reacts to tuberculin and has no other evidence of ill-health beyond the tuberculin reaction is manifestly absurd. On the other hand, a negative reaction to tuberculin or a reaction to a 1 : 10 dilution only practically rules out tuberculosis.

X-ray in Diagnosis.

I do not propose to say much about this. It is essential that the readings be made by an expert in skiagraphy. X-rays are useful in checking the progress that is being made under tuberculin. My general impression is that, from an X-ray point of view, hilum gland tuberculosis improves to a remarkable extent under tuberculin therapy. The same improvement is not seen with regard to the fibrotic condition. Does not this point to fibrosis, in some cases, being due to a mixed infection rather than to T.B. pure and simple? If so, it must be an argument in favour of dealing with mixed infection as well as with T.B.

Symptoms.

Amongst the most important symptoms in the early stages are: Loss of weight, pain sometimes referred to the abdomen, dyspepsia, loss of energy,

neurasthenia, protracted colds, hæmoptysis, rapid pulse, low blood-pressure. Of course, many of these symptoms simply point to a toxæmia and may be due to other causes than T.B., but a combination of certain of them with a well-marked modified Von Pirquet points to the probability of early T.B. The indication is then for treatment by tuberculin. In the more advanced stages, with definite physical signs and T.B. positive sputum, I have found treatment with tuberculin, on the whole, to be disappointing.

A word as to blood-pressure. Though it is the rule to have a low blood-pressure in early tuberculosis, it is by no means always so in the more chronic cases. I found [3] that the average systolic blood-pressure in 100 tubercular officers was 135 millimetres; if there was much fibrosis it tended to be considerably higher. Dr. Francis Brook [4] states that rises in blood-pressure may be due to sepsis. I have frequently found in studying insurance reports that a history of fairly recent sepsis is frequently accompanied by high blood-pressure. The question is not purely academic. It is a further indication that the fibrosis may be due to so-called secondary organisms, and this may have an important bearing on treatment.

With regard to colds in the tubercular [5], I have not had good results by treating them with stock vaccines, and of 28 cases 16 did well, but in 12 the colds became worse and I gave up the treatment. I have since realized that my dosage was probably too large initially, and too rapidly increased. The same care is needed in administering a "cold" antigen to the tubercular as with tuberculin itself.

Below I give a résumé of my results of cases treated with tuberculin during the past six years.

T.B. Positive Cases.

Twelve cases. Four were definitely improved, 4 slightly or not at all improved, 4 died.

As far as it is possible to judge no case was made worse by tuberculin, at the same time I do not consider it is the most satisfactory way of treating open tuberculosis. The chief danger in open tuberculosis is the mixed infection and it seems reasonable to treat this by autogenous vaccines. Dr. Brady deals with the rationale of this method of treatment at the end of this paper.

T.B. Negative Cases but with X-ray Evidence of Lung Changes.

Thirty cases. Of these 11 showed fibrotic changes of which 4 were definitely active, 7 not active; 14 showed changes in the hilum glands, 2 definitely active, 4 not active; 4 cases showed mere haziness; and 1 case showed a cavity not active.

Results.—Twenty-two cases were treated by tuberculin injections, eight by some form of tuberculin inunction. Every case improved to a remarkable extent. Certainly more brilliant results were attained by injections, but the simplicity of the method of inunction far outweighs the problematical

advantages of injection. I am of the opinion that the high state of immunity obtainable by injection is unnecessary in the majority of cases of this class.

T.B. Negative Cases and X-ray Normal.

Twenty-seven cases. These consisted of a miscellaneous group. Enlarged cervical glands 4, constant cough 7, loss of weight 2, T.B. abdomen 1, neurasthenia 4, bronchitis 2, colds 2, "run down" 2, hæmoptysis 1, T.B. testicle 1, T.B. spine 1.

Results.—Eight were treated by injection, the remainder by inunction. All did remarkably well. I never now treat this class of case by injections.

Tubercular Asthmas.

I would define a tubercular asthma as asthma occurring in a patient who reacts definitely to tuberculin or has X-ray or other evidence of T.B., and in whom there is no discoverable cause of the T.B. beyond the tubercular factor. The following are the main characteristics of tubercular asthmatics :—

(1) They all react to tuberculin and, as a rule, they are not particularly sensitive ; for example, of 51 cases who were tested 10 per cent only reacted to 1 : 500, 60 per cent to 1 : 100, and 30 per cent to 1 : 10.

(2) The blood-pressure is about normal for the age.

(3) *Skiagraphic Appearances.*—I find that of these 51 cases 66 per cent were normal to X-rays, in 11 per cent there was definite fibrosis, in 7 per cent the hilum glands were enlarged and in 16 per cent the apices were definitely affected. The comparatively large number of apical affections is significant.

(4) *The age of onset* seems to vary considerably. I have seen cases in which it began at the age of 4, and others in which it started at over 50.

(5) A definite family history of asthma is rare, but of T.B. not uncommon.

(6) The general health of these patients is not, as a rule, good. They seem to be suffering from a mild degree of toxæmia. This is contrary to what one usually finds in other forms of asthma in which the patient is often in good health between the attacks.

Treatment.

Tuberculin seems to act almost as a specific, though the effect is seldom immediate ; there is at first an improvement in health, then the attacks get less severe and finally cease. At one time I used tuberculin injections but equally good results are obtained by skin medication in the form of "Santubin" ointment. Out of fifty-one cases only four could be said to be failures. I agree with Dr. Gordon Tippett [6] that better results are got by combining tuberculin therapy with a mixed vaccine of other organisms grown from a swab of the tonsils or from the sputum.

Conclusions.

Up to about a year ago I had come to the following conclusions :—

(1) That tuberculosis in the early stages or when quiescent is amenable to treatment by tuberculin.

(2) That for practical purposes some form of skin medication is preferable to injections.

(3) That open tuberculosis should not be dealt with by tuberculin.

(4) That asthma of tubercular origin is commoner than is usually supposed and is particularly amenable to tuberculin therapy.

(5) That treatment of catarrhal conditions in the tubercular by stock vaccines is unsatisfactory.

(6) That tuberculin has little effect on fibrosis and that frequently after a course of tuberculin the X-ray shows evidence of activity.

In other words the value of tuberculin, though great, was more limited than, at one time, I supposed. I began more and more to confine my field to very early cases and to tubercular asthmas. About a year ago I had the good luck to meet Dr. Brady. We are now working in collaboration. The general principle on which we work is for Dr. Brady to deal with the mixed infection, tuberculin, when thought desirable, being administered by skin medication. The results have been most happy and are much better than when the treatment was with tuberculin alone.

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[1] "The Diagnosis of Tuberculosis by Tuberculin," *Lancet*, 1916.
[2] "Sidelights on Tuberculosis," *Journ. Roy. Army Med. Corps*, 1926.
[3] *Ibid.*
[4] "Actinic Practitioner," 1929.
[5] *Brit. Med. Journ.*, 1924.
[6] *Ibid.*, 1933.

REMARKS BY DR. BRADY ON THE SECONDARY INFECTIONS IN PULMONARY TUBERCULOSIS.

Pulmonary tuberculosis is very rarely a pure infection when diagnosed; there is usually a second involvement due to the invasion of the T.B. focus with the micro-organisms of the respiratory tract. The history of pulmonary tuberculosis points very much to this fact. It usually begins with a cold, tonsillitis, whooping-cough or bronchitis. So much so that certain commentators are inclined to the opinion that the T.B. condition is secondary to the pathological disturbance caused by the other organisms, an opinion which is open to a considerable amount of justified discussion. One fact must be kept in mind and that is, that the tubercle bacillus itself is less virulent than any of the other organisms involved in the tubercular focus.

The authorities who hold that the other organisms in a T.B. sputum are leading a saprophytic existence in the broken-down material prepared for them by the T.B. leave themselves open to strong criticism, as all those organisms have the same morphological characteristics as those

which produce bronchitis, pneumonia and similar pathological lung conditions. Every organism in the respiratory tract is latently pathogenic. It only requires a lowering of resistance to turn it into an active pathogenic one. One or more of the catarrhal producing organisms are always to be found in tubercular sputum. They can be seen phagocyted by desquamated alveolar cells and polymorphonuclear leucocytes. The presence of a polymorphonuclear leucocytosis indicates an infection other than T.B. These microbes can be grown from a piece of sputum, the outer layers of which have been washed away.

If these microbes are infecting the lung, inoculation with a vaccine made from them should produce focal reactions. These certainly do occur. Most of the physical signs of pulmonary tuberculosis can be caused by these organisms.

The commonest organisms isolated from tubercular sputum are a mixture of the Gram-negative cocci of the *Micrococcus catarrhalis* group and streptococci. In a large number of sputa examined for T.B. the presence of a *Streptococcus longus* is very often seen. When this organism is found with the tubercle bacillus, the prognosis is nearly always bad. I am convinced that to do any good with a case like this an antigen dealing with both organisms is essential.

Now in the treatment of T.B. by the immunization method one must also realize that at the focus of infection the T.B. is also present. This being so, to get the best possible results one must provide an antigen for the T.B. as it is necessary to increase the resistance to each and every one of the organisms at the focus of infection. Tuberculin gives one the antigen for the tubercle bacillus. Every physician has his own tuberculin.

If there be much bronchial catarrh and sputum one likes to get the treatment for this under way before starting immunization with tuberculin. The initial dose of the antigen should be very small, i.e. one million of a streptococcus and one million of a staphylococcus. The effect of the vaccine is a rapid change for the better in the physical phenomena and especially in a reduction of the evening temperature. I have seen the small dose above referred to reduce a temperature of 100° to 96° F. in twenty-four hours. A negative phase with these small doses is often absent.

In estimating the value of this form of treatment one looks for the following results: (1) Disappearances of symptoms and physical signs; (2) a negative sputum after repeated examination; (3) disappearance of X-ray signs of activity.

A case illustrating the methods of treatment employed :—

Mrs. V. G., aged 36, April, 1929.

History.—Patient had tubercular glands at the age of 21. Her father was accidentally killed and at the autopsy actual tubercular glands were found in his lung. Six months ago the patient began to feel tired, lackadaisical and lost interest in life. She developed a cough with catarrh, etc.

The chest was carefully examined but no clinical signs of tuberculosis were present.

Examination of sputum revealed tuberculosis, and an X-ray plate revealed a very small cavity in the left apex which was drained by a bronchus—whence the tubercle bacillus in the sputum.

The secondary organisms were *Str. longus, M. catarrhalis, M. flavus.*

The antigen was made in the following strengths 1 (million *Str. longus*) + 1 (million *M. catarrhalis*) + 1 (million *M. flavus*), 2 + 2 + 2 and so on, doubling the dose on each successive occasion, unless a reaction occurred, i.e. rise in temperature, malaise, etc., when the next dose was reduced, leaving two clear days interval after all signs of reaction had settled down.

The tuberculin dose was given alternately with that of the antigen, taking the same precaution regarding reaction.

A plate taken after six months treatment, showed the cavity very much reduced in size with much clearer parenchyma.

A plate taken finally showed the cavity completely healed. At this time there was no sputum. The patient had put on about two stone in weight and was carry out her usual occupation.

The last report in February, 1933, showed patient maintaining improvement without any sign, clinically, of the condition.

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NOTE ON EXPERIMENTS MADE WITH THE OBJECT OF FINDING AN EFFICIENT AND ECONOMICAL INSECTICIDE SPRAY FOR THE DESTRUCTION OF MOSQUITOES AND FLIES.

By Captain E. BABER,

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The primary object of these experiments was an endeavour to find an insecticide for the destruction of mosquitoes and flies which would comply with the standards of efficiency and economy laid down by the Union Department of Public Health.

In the preliminary tests, flies (*Musca domestica*) were used as a basis for experiments as it was thought that a spray effective in the destruction of flies would be equally or more so against mosquitoes. Flies were specially bred out from larvæ obtained by means of the fly-larval-trap manure midden, as described in The Journal of the Royal Army Medical Corps, December, 1925. The flies were suitably fed for four days, and only active, healthy insects were used. Later, large numbers of mosquitoes (*Culicinæ*) were bred from larvæ collected in the surrounding district and these were fed on fruit for three days prior to testing. Altogether many hundreds of tests were carried out by the writer.

At the outset standard advertised proprietary preparations were pur chased from local stores and these were submitted to test with the object of obtaining a basis upon which to work and to give some idea of what results might reasonably be expected. This was followed by tests with a number of reagents, published formulæ, and particularly with liquid extracts of pyrethrum. Tests were also made with naphthaline, dichlorbenzol, formalin, thymol, betanaphthol, cresol, creosote, methyl salicylate, carbon tetrachloride, sodium fluoride, oil of sassafras, oil of citronella, pyrethrum powder, turpentine, varnoline (turpentine substitute), petrol and paraffin oil.

As the object of the experiments was to find an efficient but inexpensive insecticide, more particularly for the destruction of mosquitoes, many formulæ containing one or more of the above ingredients are not detailed in this article, the chief reasons for their rejection being one or other of the following: (*a*) recovery rate high, resulting in a low index figure of insects killed; (*b*) killing power satisfactory but too costly for general use; (*c*) pungent, causing either conjunctival or nasal irritation; (*d*) use limited owing to inflammable qualities.

As the tests proceeded, the sprays giving the best results when employed against flies were noted for further test against mosquitoes, unsatisfactory reagents and formulæ being discarded.

Household insecticides may be subdivided in their composition as follows: (*a*) the reagent, containing the principal killing properties; (*b*)

the perfume (usually essential oils), which may also act to some extent as a killer or as a repellent; (*c*) the vehicle, which acts as a carrier of the active killing ingredients.

Technique in Carrying Out Tests.

The insects were passed into spherical shaped wire-gauze cages, twenty insects per cage; for testing purposes each cage was placed beneath a metal container having a capacity of 0·65 cubic feet.

The solution to be tested was atomized by means of a small glass nebulizer, as used for throat sprays, the nebulizer being placed beneath the slightly tilted metal cover as far removed from the cage as possible, and a specified number of pressures made upon the bulb of the nebulizer. After a lapse of thirty minutes the cover was removed and the results observed. The cages were now given free ventilation and further observations were made at the end of one hour and twelve hours. The number of insects lying apparently dead at the bottom of the cages was recorded at each observation. The test in the case of each solution was frequently repeated with the object of counteracting any possible source of error likely to give inconsistent results and most of the solutions were submitted to ten or more separate tests.

After carrying out some initial experiments it was decided to submit flies to two series of tests, viz., ten pressures and thirty pressures upon the bulb of the nebulizer. The latter test gave an index figure of sixty-five per cent killed in the case of the most effective proprietary spray tested and, therefore, was considered to be a fair basis upon which to work. In the case of mosquitoes it was found that one pressure and ten pressures upon the bulb were sufficient. Those sprays giving the best results in the killing of flies were later tested against mosquitoes.

An endeavour was made to maintain the conditions as to temperature and humidity as evenly as possible throughout the tests, but detailed figures in this connection were not recorded.

It will be noted that fluids were finely atomized and that they were not sprayed immediately upon the insects, the intention being that the insects should be affected by the fumes only. It is thought that if a spray is to be of any value in the destruction of mosquitoes it must kill those insects which might be concealed beneath beds, behind and below furniture, and among the folds of curtains, as visible and accessible insects hardly require spraying, an ordinary hand swatter being all that is required. Further, to direct a heavy spray immediately on insects provides little proof of the efficacy of an insecticide, for even ordinary paraffin oil will kill most insects if actually coming in contact with them.

Recording Results.

The percentage of insects found to be dead after a lapse of twelve hours was recorded after each test and the result given by each formula or solution

over the full series of tests was averaged; this figure was termed the Index Figure of Insects Killed.

The results were tabulated as follows:—

Average Percentage Dead 12 hours after Spraying.

Flies	10	pressures on bulb.	30	pressures on bulb.
Mosquitoes	1	pressure ,, ,,	10	,, ,, ,,

Generally it may be said that the effect of insecticides is first to stupefy and paralyse the insects and subsequently, depending upon the degree of efficiency of the spray, a proportion of the insects die, otherwise they recover.

None of the solutions employed, whether proprietary or otherwise, was 100 per cent efficient, and most of them gave an amazingly high percentage of recoveries, and although insects were stupefied for an hour or more recoveries in periods of from three to twelve hours were frequently as high as 100 per cent. Most recoveries occurred after a lapse of two or three hours, and insects which in the early stages appeared to be dead were found to recover in such large numbers as to render valueless some formulæ which at first seemed to be very promising.

The tests clearly demonstrated the futility of judging the killing powers of an insecticide by the number of insects apparently dead after the lapse of a period of three hours or less. Such a method of assessing the effective killing powers of a spray has been shown by these experiments to be almost valueless.

Susceptibility of Mosquitoes.

As a result of the tests it was observed that mosquitoes are infinitely more susceptible to the action of insecticide sprays than flies, and that an indifferent fly-killing fluid might be a fairly efficient mosquito destroyer, whilst an insecticide of only moderate efficiency when employed against flies may be 100 per cent efficient against mosquitoes. An examination of the figures given in the table demonstrates the fact that a higher kill results with mosquitoes than with flies even though but one-thirtieth the quantity of the insecticide be used in the case of the former. It was further observed that mosquitoes appear to be remarkably susceptible to insecticides prepared from good quality extract of pyrethrum.

The mosquitoes used in these experiments were principally Culicini. Doubtless it would have been better to have used Anophelini, but these were not obtainable in sufficient numbers for the purpose; however, there appears to be no reason to suppose that they have a higher degree of resistance to the action of insecticides than Culicini, Anophelini being considered even more delicate than culicinæ.

Proprietary Sprays.

There is a large number of proprietary sprays on the market. Many of these are made in the United States, some are made in the Union and, with few exceptions, they all appear to employ pyrethrum as the killing agent.

As indicating the enormous public demand for fly sprays it is stated that 25,000,000 dollars worth of insecticides were sold in the United States in 1931.

Proprietary-prepared fly spray solutions vary considerably in killing powers, although each manufacturer claims his particular spray to be 100 per cent. efficient, which is far from being the real position. In the case of one manufacturing firm various grades of fly sprays are made up and sold under different titles, the cheapest being specially prepared for the multiple bazaar business; the cheaper fly sprays probably contain a smaller proportion of the somewhat expensive killing agent, but a larger proportion of mineral oil, and for this reason a cheap spray may be almost worthless.

One advantage of proprietary sprays is the fact that they are carefully packed in special containers for distribution and sale, but these containers add considerably to the cost of the fluid, particularly in the case of the smaller size receptacles.

None of the published non-proprietary formulæ which were submitted to test gave killing results equal to the better grades of proprietary-prepared fly-spraying solutions. Doubtless the reputable manufacturer of highly advertised products takes considerable pains to obtain a high grade pyrethrum extract, as otherwise the product will ultimately fall into disfavour. Instances of fairly well known but inefficient insecticide sprays falling entirely out of the market have occurred.

In view of the great variation in the efficiency of prepared proprietary insecticide sprays, it would appear to be desirable that the public and reputable manufacturers should be protected by a law requiring insecticides to comply with some biological standard of efficiency and that they be graded accordingly.

Naphthalene.

Naphthalene has shown some promise as a killing ingredient in fly sprays and its low cost is an important factor.

Crude naphthalene is a hydrocarbon occurring in coal tar.

Naphthalene is soluble in 1 in 25 alcohol, 1 in 1½ chloroform, 1 in 3 ether, 1 in 7½ turpentine.

The naphthalene available was in the form of ordinary commercial naphthalene balls and flaked naphthalene; it is quite possible these were not of the most suitable type.

In the application of naphthalene as an insecticide for the destruction of lice, Bacot recommended the use of crude, drained, unwhizzed naphthalene from modern coke ovens, that obtained from gas plants being far less efficient.

Naphthalene was experimented with in various admixtures, the solvents employed being ordinary paraffin oil burning fluid, chloroform and methylated spirit; additions were made of carbon tetrachloride, dichlorbenzol,

and oil of sassafras, but these additions made no very appreciable improvement in the killing powers of the resultant solution.

It was generally found that within thirty minutes of spraying practically all insects were stupefied and lying still on the bottom of the cages, but when these insects were exposed to free ventilation they recovered so rapidly that at one hour a considerable proportion had recovered, whilst after a lapse of twelve hours the recoveries reached 40 per cent. in the case of thirty pressures on the bulb, and 70 per cent. in the case of ten pressures.

A simple saturated solution of naphthalene in ordinary paraffin oil when tested against flies gave an index figure of insects killed of 60 per cent. This may be regarded as a moderately effective fly spray and has the advantage of very low cost, though its use in a closed room causes the operator slight nasal and conjunctival irritation. Mosquitoes proved to be relatively less susceptible to its influence than flies.

Pyrethrum Extracts.

The tests revealed the definite superiority of spraying solutions containing pyrethrum extracts, and mosquitoes proved to be peculiarly susceptible to insecticides prepared from a good grade of liquid extract of pyrethrum.

The preparation of sprays from ordinary commercial pyrethrum powder by the somewhat rough and ready means of soaking the pyrethrum powder in oil for twenty-four hours and subsequently filtering did not give satisfactory results, and no better results were obtained when pyrethrum powder was percolated with chloroform or methylated spirit.

Liquid extract of pyrethrum, as prepared by manufacturing chemists, having proved in the experiments to be so potent in the preparation of sprays for the destruction of mosquitoes, a few remarks thereon may not be out of place.

Pyrethrin, the active principle of the pyrethrum plant, whilst highly toxic to insects, is harmless to man and warm-blooded animals. It is manufactured from pyrethrum flowers, and these must be of selected quality. The best are considered to be the half opened flowers. These flowers are cultivated principally in England, Japan and Dalmatia, and are specially cultivated to produce the greatest possible percentage of pyrethrin. The activity of different samples of flowers varies considerably and it is stated that in some instances the disparity between them may be as much as 300 per cent.

To produce a pyrethrum extract of uniform killing power it is necessary to standardize the preparation according to the activity of the flower rather than the quantity used, the quality of the extract being finally confirmed by biological tests.

Ready prepared pyrethrum extracts of very high potency are now obtainable from manufacturing chemists and provide a ready and easy means of making up a useful insecticide, having a killing power equal or

superior to the advertised proprietary household insecticides, which are very much more costly.

Prepared pyrethrum extracts at first glance may seem to be very costly; but when it is considered that some are used in a proportion of 1:65 when mixed with oil in the preparation of sprays, the cost will be such as to permit the preparation of an insecticide and its extensive use, an important point for consideration in antimalaria work.

When comparing the costs of liquid extracts of pyrethrum it is necessary to note the concentration required when mixed for use, as this varies with the different makes and thus considerably affects the cost of the final product.

The following are some details with regard to those pyrethrum extracts which were available in the Union and which were submitted to tests, the results of which are indicated in the table.

The pyrethrum extract which gave the best result was that of Messrs. Stafford Allen and Sons, Limited, Manufacturing Chemists, England. This firm appears to specialize in pyrethrum extracts and cultivates the pyrethrum flowers upon their own farms in Suffolk. The extract is very highly concentrated and is stated by the manufacturers to be biologically standardized; they prescribe its use in a proportion of 1 : 64 with paraffin oil. The tests showed that even if used in double this dilution it gave an insecticide with high killing powers when employed for the destruction of mosquitoes.

A pyrethrum extract which gave good results was that of Messrs. Gale and Co. Limited, Wholesale Chemists, London. It is also used in a proportion of 1 : 65 with paraffin oil.

Pyrocide No. 20 is another liquid extract of pyrethrum and can be obtained from the Standard Oil Co. in South Africa; it is used in a dilution of 1 : 20 with paraffin oil.

Pyagra Concentrate, another pyrethrum extract, is made in South Africa by the Creek Chemical Works, Durban; usable in a dilution of 1 : 12 with paraffin oil.

The water soluble preparations of extract of pyrethrum, so largely used against agricultural pests, were found unsuitable for the preparation of insecticides for the destruction of flies and mosquitoes.

Liquid extract of pyrethrum was submitted to tests in varying dilutions and with the addition of different classes of essential oils.

Oil of citronella being widely used for its repellent effect against mosquitoes, and being one of the cheapest of the essential oils, was tested out in combination with liquid extract of pyrethrum and when added in a proportion of 5 per cent. was found to cause a very definite increase in the index figure of insects killed, more than sufficient to justify the additional cost of its inclusion.

Of the liquids tested for suitability as vehicles for the preparation of insecticide sprays, ordinary standard quality household paraffin-oil-burning

fluid was found to answer satisfactorily, and it was decided to increase its volatility by adding 15 per cent of petrol. With reasonable care this mixture should not be of such an inflammable nature as to render its general use dangerous. When used with a volatiliser pump it does not stain fabrics or injure furniture.

The formula finally resolved upon as providing a highly efficient insecticide at a low cost was the following, 1 : 64 Stafford Allen's liquid extract of pyrethrum + 5 per cent oil of citronella + 15 per cent petrol + paraffin oil (ordinary burning fluid).

This formula was found to give the highest index figure of insects killed of any formula submitted to test. An insecticide made up according to this formula has recently been prepared under the joint direction of the Union Department of Public Health and the Department of Defence and is distributed under the name of "Hysec 350," at a little above cost price for use of Government Departments and Local Authorities in the Union. It has been well reported upon by users and arrangements have been made for the supply of large quantities during the approaching warm season 1933-1934.

The question of the type of spray pump which should be used has not been dealt with in this report, but a well-constructed pressure pump is recommended, which should provide good atomization so that the insecticide is thoroughly distributed.

Summary.

(1) The tests made of insecticide sprays indicated a high percentage of recoveries in periods of from three to twelve hours and demonstrated the futility of judging the killing power of an insecticide by the number of insects apparently dead after the lapse of three hours or less.

(2) The efficiency of prepared proprietary insecticides was found to vary considerably. The fixing of some specified biological standard of efficiency for insecticide sprays would appear to be desirable.

(3) A simple saturated solution of naphthalene in paraffin oil was found to provide a moderately effective insecticide spray. Its low cost is an important consideration.

(4) Mosquitoes proved to be infinitely more susceptible to the action of insecticide sprays than flies. A higher kill resulted with mosquitoes than with flies even with one-thirtieth the quantity of insecticide spray.

Mosquitoes were found to be peculiarly susceptible to the action of insecticides prepared from liquid extract of pyrethrum.

(5) Prepared extract of pyrethrum proved to have very high killing powers and to provide a ready means for the preparation of a useful insecticide. The addition of oil of citronella resulted in a definite increase in the killing powers of pyrethrum extracts.

(6) A formula which included prepared liquid extract of pyrethrum, oil

of citronella, petrol and paraffin oil was found to provide a very efficient and economical insecticide for the destruction of flies and mosquitoes and gave results superior to all others tested.

In conclusion I would thank Colonel Sir Edward Thornton, K.B.E., Director of Medical Services, for his interest in these tests and for permission to forward these notes for publication.

TABLE.

RESULT OF TESTS OF SOLUTIONS GIVING INDEX FIGURE OF INSECTS KILLED.

Solutions tested	Mosquitoes: Pressures on bulb: One	Mosquitoes: Pressures on bulb: Ten	Flies: Pressures on bulb: Ten	Flies: Pressures on bulb: Thirty
Paraffin oil (burning fluid)	0	0	0	0
Petrol	0	0	0	0
Turpentine	—	—	5	15
Varnolene (turpentine substitute)	—	—	20	25
10 per cent citronella oil in paraffin oil	—	—	7	16
10 per cent sassafras oil in paraffin oil	—	—	10	15
10 per cent methyl sal. in paraffin oil	—	—	7	18
Pyrethrum powder, 1 lb. per gal. in paraffin oil ..	10	70	20	26
do. do. + 5 per cent citronella oil ..	—	—	17	48
Pyrethrum powder in chloroform + paraffin oil ..	—	—	10	25
1/64 Stafford Allen's ext. of pyrethrum + 5 per cent citronella oil + 15 per cent petrol + paraffin oil..	78	100	48	73
do. do. but diluted with equal parts of paraffin oil	40	90	—	—
1/64 Stafford Allen's ext. of pyrethrum + paraffin oil	49	100	48	61
do. do. + varnolene	—	—	47	69
do. do. + 15 per cent petrol + paraffin oil	—	—	49	64
1/12 pyagra ext. of pyrethrum + paraffin oil ..	62	100	43	58
1/20 do. do. do. + do ..	34	90	25	28
1/65 Gale's ext. of pyrethrum + 15 per cent petrol + paraffin oil	38	100	38	63
1/20 pyrocide ext. of pyrethrum + paraffin oil ..	—	100	36	44
do. do. do. + 5 per cent methyl sal. + 15 per cent petrol + paraffin oil	—	—	43	53
1/13 pyrocide ext. of pyrethrum + 15 per cent petrol + paraffin oil	—	—	22	46
Naphthalene, 10 per cent in paraffin oil ..	7	60	30	60
Prepared Proprietary Sprays.				
Proprietary spray A	71	—	37	65
do. do. B	13	—	34	60
do. do. C	32	—	25	57
do. do. D	28	—	35	41
do. do. E	12	—	7	38
do. do. F	40	—	—	—
do. do. G	17	—	—	—

N.B.—A dash placed in columns indicates no test carried out.

Editorial.

MODERN VIEWS ON VITAMINS AND THEIR FUNCTIONS.

In the July number of the Journal, 1932, we wrote an editorial on recent work on vitamins. At that time a good deal of evidence had accumulated showing that carotene may be converted into vitamin A. More than ten years ago Steenbok found that when foodstuffs of plant origin were arranged according to their carotene content, their vitamin A potency was in the same order. But when he tested the efficiency of carotene obtained from plants as a source of vitamin A for animals he did not obtain conclusive results. It has now been shown that carotene will replace vitamin A if vitamin D be supplied as well. Moore showed that the ingestion of carotene led to the storage in the liver of a substance resembling vitamin A. Drummond and Heilbron and his colleagues found that a substance could be isolated from the liver oil of the sturgeon and halibut having properties similar to those of vitamin A and which appeared to be an alcohol derived from the breaking up of the carotene molecule. Drummond believes that the vitamin A in the liver of fish is derived from the ingestion of minute marine plants, the phytoplankton, which contain carotene in about the same proportion as green land plants.

As regards the functions of vitamin A, the work of Green and Mellanby appeared to suggest that during pregnancy an extra supply of vitamin A would confer an increased resistance to bacterial infection. But Moore has found abundant vitamin A reserves in many infective conditions so that it cannot be considered as an anti-infective agent indiscriminate in its action. Griffith observed that the resistance to tuberculosis is not diminished by vitamin A deficiency.

At Sheffield Mellanby discovered that vitamin A deficiency in combination with a high cereal intake produced demyelination of the cord. He is continuing his experimental work on the nutritional control of the nervous system. He has found that many afferent nerves, including the second, fifth, and eighth cranial nerves, show degenerative changes when the diet is deficient in vitamin A and rich in cereals.

Mrs. Mellanby's experimental work has demonstrated that a deficiency of vitamin A or carotene plays an important part in the development of the periodontal tissues. Up to the present time these observations have not been applied to man, but that they can be so extended is strongly supported by the distribution of periodontal disease in different races. It is found that natives in many tropical regions are nearly free from caries but are subject to periodontal disease when their diet consists largely of white maize and little green vegetables and their bodies are exposed to sunshine.

In Denmark during the Great War outbreaks of xerophthalmia in

children appeared to be due to the consumption of margarine instead of butter and when the Government ordered the addition of a certain amount of butter to margarine xerophthalmia promptly disappeared. The characteristic change in vitamin A deficiency is a development of stratified keratinizing epithelium and further observations on xerophthalmia have indicated a probable relationship between degeneration of the nerves and a tendency to infection of epithelial surfaces. It has been shown that xerophthalmia is always accompanied by degeneration of the afferent fibres of the trigeminal nerve and it appears likely that the pathological changes in the eye in this condition are secondary to a loss of trophic control.

Much work has been done on the vitamin B complex, and animal experiments seem to show that there are five or six entities, but B_1 and B_2 are the most important from a clinical point of view. Impure crystalline preparations of B_1 were first obtained by Jansen and Donath from rice polishings. In the last two years crystals of greater purity have been obtained, and in two laboratories, including that of Professor Peters at Oxford, from an original source of yeast. The hydrochloride of the base separates from acid absolute alcohol solution in glistening plates. The crystals prepared by different workers are alike in general properties, but differ in potency and chemical composition. They contain sulphur and those from rice polishings appear to have the formula $C_{12}H_{18}O_2N_4S\ 2HCl$. Peters thinks that the differences between preparations in different laboratories can be explained by the presence of varying admixtures of inactive and active vitamin. Activity appears to follow the sulphur content, but it is not certain that pure vitamin B_1 has yet been obtained.

Vitamin B_2 has been divided by German workers into two fractions. The crystals are called flavines; ovoflavine from egg white has the formula $C_{17}H_{20}N_4O_6$, is yellow with a green fluorescence and is highly sensitive to light. Peters thinks this last point may be of importance in relation to the light sensitivity of pellagrines and if confirmed it is a striking development of the discovery of vitamin B_2, unaccompanied by vitamin B_1, in egg white by Chick and her colleagues. Peters considers the most important point to be an apparent relation between vitamin B_2 and the essential constituent of Warburg and Christian's new oxidizing enzyme. Such a relation between vitamins and enzymes has often been sought before in vain. A colourless form of apparently the same substance has been prepared by White in Professor Drummond's laboratory. Both the forms are stated to be equally effective in animal experiments.

Vitamin B_1 action is very complicated and much work has been done on the "B complex" by Peters and others at Oxford. At first it was considered that vitamin B deficiency led to retardation of growth, atrophy of organs, more especially those of the digestive system, anæmia, failure of reproduction, loss of appetite, reduced oxidative processes and polyneuritis. It was found that loss of appetite and subsequent inanition were the cause of some of these symptoms; there was no evidence of

impairment of the oxidative system of the tissues. Professor Woollard on examining experimental animals living on a diet deficient in vitamin B_1 concluded that the "polyneuritis" symptoms were less those of a peripheral neuritis than of a central lesion. He also showed that many of the "degenerations" in nerve specimens were probably due to faulty technique in their preparation. "Head retraction" in pigeons was found not to be a characteristic of vitamin B deficiency, for it was found in cases of starvation without deficiency of vitamin B, and Hess showed that the condition could be produced by sublethal doses of cyanide. It was discovered by Professor Peters and his co-workers that an accumulation of lactic acid in the brain invariably accompanied the head symptoms in pigeons deprived of vitamin B; they then found that in such cases there was an inhibition of the oxidative process in the brain. They also made the important discovery that administration of the vitamin either to the living animal or to *in vitro* preparations restored the oxygen uptake to normal. Subsequent work showed that the action of vitamin B_1 is particularly related to the metabolism of lactic acid in the brain.

The action of vitamin B_2 is still little known, but deprivation of the vitamin leads to retardation in the growth of animals and to the appearance of symptoms which some regard as being those of pellagra, though others consider them to be "pseudo-pellagrous."

The experimental study of vitamin B_2 deficiency has been made chiefly on young rats. These animals when fed on a diet deficient in B_2 develop a symmetrical dermatitis which was considered by Goldberger to be analogous to that seen in human pellagra. Dogs fed on diets deficient in B_2 develop severe stomatitis, "black tongue," which resembles another phase of pellagra symptomatology.

Akroyd and Roscoe arranged a list of cereals and other foods in the order in which they have been found effective for the prevention and cure: (*a*) of vitamin B_2 deficiency in rats; (*b*) of human pellagra in communities where the disease is endemic; (*c*) of black tongue in dogs. The striking similarity in the quantitative distribution among these foods of the dietary factor concerned in the prevention of these three diseases led irresistibly to the conclusion that they must be regarded as analogous.

It is, however, difficult to understand the almost universal association of epidemic pellagra with unbalanced diets containing maize as the staple cereal. Maize has not been found inferior to wheat or rice in content of vitamin B_2, yet a population subsisting too exclusively on these cereals does not develop pellagra, but beriberi. Rice endosperm was found to be the poorest in vitamin B_2 of all the cereals tested, yet among rice eaters pellagra is somewhat of a rarity.

Mellanby has shown that the nervous symptoms of pellagra can be produced by deficiency in vitamin A combined with the toxic action of some substance present in white maize. The nervous symptoms are not produced by yellow maize as this contains vitamin A.

Wilson maintains that shortage of protein of good biological value is the main cause of pellagra, though he admits that many of the sources of protein may contain moderately large amounts of vitamin B_2.

Dr. M. Fixsen working under the direction of Dr. Chick on the proteins of wheat and maize in the support of growth and development has found them to be nearly equal in this respect. This result confirmed that obtained in previous work where maintenance of nitrogenous equilibrium was the criterion used, and does not support the theory that pellagra results from the low nutritive value of the protein in diets containing maize as a staple constituent.

Dr. Chick considers that the known facts concerning the ætiology of pellagra are in accord with the theory postulating a toxic substance in maize and other pellagra-producing diets (or produced therefrom by metabolic processes in the body) for the neutralization of which poison an abundant supply of vitamin B_2 is required.

The identification of vitamin C is of much scientific interest, as well as of great practical importance. It has been known for years that in the juices of the citrus plants there is a substance which in quite small quantities prevents scurvy.

In 1924, Dr. S. S. Zilva, working for the Medical Research Council at the Lister Institute, discovered that a strong affinity for oxygen—or reducing power—was invariably shown by active concentrates of the vitamin.

In 1928, Dr. A. Szent-Györgi, while studying a different problem, isolated a substance "hexuronic acid" from the cortex of the suprarenal gland. He showed that the reducing power of this acid was similar to that described by Zilva for vitamin C concentrates. He also demonstrated its presence in various vegetable tissues.

In 1932, Professor Tillmann and his co-workers in Germany suggested on the basis of the constant relation of reducing power and antiscorbutic potency of natural lemon juice that the properties described by Zilva were those of the vitamin itself, and that the vitamin was identical with the hexuronic acid of Szent-Györgi.

In April, 1932, Svirbely and Szent-Györgi showed that hexuronic acid (in 1933 called ascorbic acid by Szent-Györgi) had an antiscorbutic action. They found that hexuronic acid fed at a level of one milligramme per day protected guinea-pigs over the usual ninety-day test period. They therefore concluded that vitamin C is a single substance identical with hexuronic acid. Zilva, however, pointed out that he had obtained fractions active in doses of 0·5 milligramme which were evidently grossly contaminated, a fact which militated against the contention that hexuronic acid and the antiscorbutic factor are identical.

In 1932 King and Waugh of the University of Pittsburgh announced that they had succeeded in isolating vitamin C, and that it had the properties of hexuronic acid.

In 1933 Svirbely and Szent-Györgi made experiments to show that the antiscorbutic activity of their hexuronic acid (ascorbic acid) preparations is due to the acid itself and not to contaminations. They obtained fairly large quantities of ascorbic acid from paprika (*Capsicum annuum*) and prepared a mono-acetone derivative. This substance was moderately active as an antiscorbutic. The ascorbic acid recovered from the mono-acetone derivative was, however, fully active. This was regarded as definite evidence concerning the identity of ascorbic acid and vitamin C. They also found that ascorbic acid from adrenal glands when recrystallized five times retained its activity.

In 1933 Dr. Zilva and Dr. Hirst examined the activity of ascorbic acid derived from various sources and their results now support the view that ascorbic acid is the pure vitamin C. Dr. Zilva and Dr. Gough have found ascorbic acid present in several organs of different animal species. The anterior lobe of the pituitary gland is very rich in the acid and has strong vitamin C activity. On the other hand the absence of ascorbic acid from the cortex of the suprarenal gland is not necessarily followed by scurvy.

At the Nutritional Laboratory, University of Cambridge, quantitative experiments have been made to determine whether hexuronic acid (ascorbic acid) is pure vitamin C, and the results show that it is so. By a new microchemical method of determining the amount of hexuronic acid applied to many different materials it has been found that the hexuronic acid content of each substance corresponds to its vitamin C activity, and destruction of the acid by chemical means causes a parallel loss of vitamin power in the material treated.

Dr. Harris has found that dogs are able to form vitamin C when fed for long periods on vitamin-C-free diets. Liver from such dogs when fed to scorbutic guinea-pigs cured them of scurvy. He also ascertained that hexuronic acid is synthesized concurrently by plants on germination.

It has been shown that rats after adrenalectomy are still able to form the vitamin. Obviously it must be formed in other places than the adrenal gland.

The conversion of ergosterol to vitamin D by ultra-violet radiation has been investigated at the National Institute of Medical Research at Hampstead and the workers there isolated a crystalline compound possessing great antirachitic properties. They named the substance "calciferol." Later it was found that this "calciferol" consisted of two substances, one of which, "pyrocalciferol," is physiologically inactive, while the other, "calciferol ii" is more active than any other substance and is now considered to be the pure vitamin. Professor Windaus also isolated the pure vitamin in the Institute of Chemistry at Göttingen. Experiments have been in progress at the National Institute on the stability of the pure substance with a view to its acceptance as an international standard in place of the empirical solution of mixed irradiation products hitherto in use. Data

accumulated over one and a half years show a remarkable stability of pure calciferol when protected from light and oxygen.

Mr. Webster has been investigating the distribution and fate of vitamin D in the animal body. In animals it is found, in contrast with vitamin A, to be distributed almost uniformly in the fat extracted from all the major organs, with the exception of the fatty constituents of the brain, from which it appears to be completely absent.

Much work has been done on the action of vitamin D on the deposition of calcium in bony tissues, which appears to depend on the concentration of calcium and phosphate ions. In normal tissues this concentration is such that calcium is not deposited and some mechanism must come into action to allow of the deposition of calcium in bones and teeth. Robison and his colleagues found that at centres of ossification and at sites where it is necessary to transport calcium and phosphates across vital boundaries an enzyme, phosphatase, can be detected, which by the hydrolysis of certain organic phosphoric esters in the blood leads to a local concentration of phosphoric acid ions and this in growing animals causes a deposition of calcium. In rickets there is a deficiency in the blood of calcium or phosphate ions, or both, and the bone enzyme cannot raise them to a sufficiently high level for the deposition of calcium. The mode of action of vitamin D in calcification is still unknown, but it is believed to cause a retention of calcium or of phosphate.

Miss Bruce and Dr. Callow have found in experimental rickets that on a diet in which the proportion of calcium is excessive in relation to phosphate the addition of some source of available phosphorus will by itself cause some degree of healing of the rachitic condition, but with the addition of calciferol the combined curative effect is much greater. The addition of cereal phosphorus, such as oatmeal, is less effective than an equivalent addition of inorganic phosphorus. This is explained by the fact that the phosphorus in oatmeal and other cereals is in the unavailable form of phytic acid.

Dr. Parks, of Vermont, U.S.A., has shown that contrary to the theory that vitamin D acts by stimulating the parathyroid glands, parathyroid hormone has no effect in increasing the net absorption of calcium and phosphorus in rickets.

Clinical and other Notes.

AN UNCOMMON TYPE OF CHRONIC NEPHRITIS.

By Lieutenant-Colonel J. HEATLY-SPENCER, O.B.E.,

and

Major H. B. F. DIXON, M.C.,

Royal Army Medical Corps.

Lance-Sergeant S. C., aged 27, was admitted to Queen Alexandra Military Hospital, Millbank, on November 7, 1933, from Bedford, where he had complained of lassitude, headache and dyspnœa. There was a history of a mild attack of tonsillitis eight days before. Some œdema of renal type was present, and the urine contained albumin. There was no history of any renal disease.

Details of urine analysis were: Acid reaction; sp. gr. 1008; albumin present (0·125 per cent.); no deposit; no casts; no sugar.

The blood showed 650 milligrammes of urea per 100 cubic centimetres.

Blood-pressure 160/100/60.

The clinical condition was typical of acute uræmic poisoning and need not be further described.

Death occurred on the seventh day after admission.

The post-mortem findings showed :—

A small left kidney weighing $2\frac{3}{4}$ ounces, with marked areas of fibrosis unevenly distributed. A right kidney nearly normal in size, weighing $4\frac{3}{4}$ ounces, with similar findings in a less advanced condition.

There were also present the common terminal complications of a pleural effusion, patchy bronchopneumonia, and recent pericarditis.

The case is one of interest in that such conditions are occasionally met with in serving soldiers. One of the writers had charge of an exactly similar case in Aldershot four years ago.

The diagnostic data which are usually definite and distinctive are as follows: (i) Complete absence of any history of renal disease. (ii) A very high blood urea. (iii) Moderate albumin with usually a few casts, no blood. (iv) Moderate hyperpiesis ranging between 140-180 millimetres mercury, systolic. Œdema. (v) No marked cardiac enlargement. (vi) Absence of albuminuric retinitis.

The cases may be summarized by stating that the *first clinical features* consist of the terminal uræmia, death occurring within a week or so of their coming under observation.

There is no effective treatment beyond temporary palliative measures such as venesection and the intravenous injection of sodium chloride, or magnesium sulphate solution.

The classification of these cases is difficult. They were originally described by Rose Bradford as a special type of contracted kidney.

Sometimes there is evidence of a degree of renal dwarfism upon which is engrafted a progressive fibrosis of the kidney without (as has been stated) the occurrence of any periodic exacerbations recognizable by clinical means.

The consensus of opinion is that they form a small separate group of chronic nephritis (small white kidney) causing early death, and distinct from chronic interstitial nephritis. In the type of case under discussion fibrosis is less evenly distributed throughout the kidney while there is considerable atrophy of the glomeruli.

In this case there were none of the recognizable symptoms of acute infective nephritis, although the patient had suffered from tonsillitis shortly before the first and final phase of his illness.

Histological report on kidneys. Both kidneys showed a chronic nephritis with marked scarring and contracture of the cortex. There was some evidence of an acute inflammatory condition supervening on this.

The lungs showed a patchy bronchopneumonia together with a pleural exudate which contained as the predominating organism a long chained streptococcus.

The authors wish to acknowledge with their thanks the pathological reports on the case by Colonel A. Dawson, O.B.E., Eastern Command, and Major H. Bensted, M.C., Royal Army Medical College.

A CASE OF CYSTICERCOSIS (*T. SOLIUM*) WITH WELL-MARKED OPTIC NEURITIS.

By Major H. B. F. Dixon, M.C.,
Royal Army Medical Corps.

and

D. W. Smithers, M.B., B.Chir.,
Civilian Medical Practitioner.

This case appears to be worthy of record, as it illustrates many of the points brought out in Colonel W. P. Mac Arthur's [1] work which do not yet appear to be fully appreciated.

(1) That optic neuritis is not an uncommon occurrence in cysticercosis, this being the fifth case in our series of sixty-two.

(2) That every case of fits occurring in a previously healthy adult who has lived in a tropical country should be regarded as a probable case of cysticercosis until it is proved otherwise.

(3) That even when full investigation fails to reveal evidence of cysticercosis, the patient should be kept under observation for a considerable time and frequent examination made for subcutaneous nodules which may come and go without even the patient being aware of them.

(4) That a negative radiogram of the skull is of no value, for in many cases where radiograms of the skull are negative, well-marked calcification

can be demonstrated by X-ray in cysts in the soft parts. Moreover, as calcification rarely takes place until at least four or five years after infestation, radiograms should be repeated at six-monthly or yearly intervals.

(5) That a diagnosis of traumatic epilepsy should not be made in those cases where there is no evidence of gross damage to the brain or skull. Such a diagnosis is dangerous, as it presupposes that all other causes of epilepsy have been excluded, and prevents further investigation.

The patient, Pensioner A, was sent to the Queen Alexandra Hospital, Millbank, on February 27, 1934, as a routine case for yearly re-boarding. This was his fourth board. The diagnosis on his board papers was "Post-Contusional Epilepsy."

His history was as follows:—

Born in 1905, of healthy stock, with no history of fits, he enlisted in 1923 and proceeded to India in 1926, where he remained until 1932. Except for minor ailments, he remained perfectly well until the end of May, 1931, when he noticed a severe and continuous headache.

On June 12, 1931, he had a fit while asleep, fell out of bed, was unconscious for two hours, and bit his tongue. A fortnight later he had two similar fits, both described as typical epileptiform fits: in one he injured his face and cut his knees and elbows on the gravel. He was then aged 26 and had served four and a half years in India.

In view of the sudden onset of fits in a healthy adult with no family history of fits, an effort was made by his medical officer to find a cause for these attacks. Careful questioning elicited the fact that in 1929 (two years previously) he had been knocked out while boxing, and later had received a blow on the head playing football. These injuries were evidently not very severe, as he never reported sick and there is no entry on his documents, though he states that he suffered from severe headache for one week after the boxing injury.

October 17, 1931: He was still suffering from severe headache, for which no organic cause could be found.

October 20: Examination of his eyes showed slight blurring of edges of both discs.

November 17: He was admitted to hospital with headache and vomiting.

November 27: There was well-marked papillœdema of both discs with hæmorrhages; maculæ normal; swelling of discs not measurable with ophthalmoscope. Various radiograms of the skull were taken at this time, but nothing abnormal was seen. The combination of headache, vomiting, and optic neuritis suggested cerebral tumour, although no localizing signs could be found. He was invalided home as "Optic neuritis (papillitis) double."

January 15, 1932: On arrival in the United Kingdom he was apparently in good health and free from all symptoms. Report on his eyes: "Subsiding double optic neuritis." He was considered fit to leave hospital and was discharged to the Army Reserve on January 21, 1932.

February 13: He was admitted to one of the London teaching hospitals. The report on his eyes was: "Definite papillœdema, especially upper

and inner part of each disc. There is no measurable swelling. About 1 disc diameter below the right disc are the remains of a small hemorrhage. There are no signs in the maps of the visual fields." He was thoroughly investigated from a neurological point of view as the question of cerebral tumour had been raised, but nothing else abnormal was found except that the pressure in the cerebrospinal fluid was 300 millimetres and ventriculography revealed extremely slight displacement of the third ventricle to the right. Blood-count showed twelve per cent of eosinophiles. The diagnosis of cysticercosis infection was considered but dismissed as the evidence was insufficient. It was decided that no surgical measures were indicated and he was discharged from hospital as "Post-Contusional Epilepsy," and this diagnosis has remained ever since on all his boards. Since then he has had numerous fits and his headache has been constant. He has been an inmate of various hospitals on account of fits and headache.

February 27 : He was invalided from the Army Reserve as "N.Y.D. Papillœdema."

May 24 : He was boarded at Millbank as "Post-Contusional Epilepsy."

February 7, 1933: He was again boarded at Millbank with the same diagnosis. There is no record that subcutaneous nodules were observed.

Eye Report: "Vision $\frac{6}{9}$, reads 0·3 R. Vision $\frac{6}{9}$, reads 0·3 L. No swelling of veins—retinal vessels normal—no sign of intracranial pressure."

February 27, 1934 : Patient came up for board and it was found that he had twenty-eight small subcutaneous nodules on his head, face, neck, chest, abdomen, back, arms and legs. There were two nodules in the tongue. When questioned about them he said he had noticed the one on his forehead for a long time, some years at least, but that he did not know that the other nodules were present. He gave no history of tapeworm. He has had about sixteen major fits in all in which he falls down, bites his tongue, and is incontinent of urine and/or fæces. The last fit was on February 25, 1934. The fits occur at any time of the day or night, there is no aura or warning of any kind, they occur as a rule every three or four months. He is a well-nourished man with no evidence of mental deterioration. Examination revealed no apparent physical signs of disease in any system beyond the nodules already noted and the examination of the eyes which revealed :—

"Vision $\frac{6}{6}$ $\frac{6}{6}$. Refraction practically normal. Fundi show perimacular retinal change at each macula. Discs show marked secondary optic atrophy, edges blurred and cup filled up; there is doubtful slight swelling of the discs still, no hæmorrhages, and no exudate seen."

Two nodules were excised and were found to be *Cysticerci cellulosæ*. X-ray examination of the long bones showed early calcification of cysts. Blood-count showed two per cent eosinophiles.

May 7: Patient re-examined. He has had one major fit since last examination. The nodules are now less tense and more difficult to find, many being impalpable. Lumbar puncture was performed; the cerebrospinal fluid was clear but under definitely increased pressure. Cell counts

showed twenty-four lymphocytes per cubic millimetre; no eosinophiles were found; the globulin and sugar content were normal. A blood-count showed 14 per cent. eosinophile leucocytes.

SUMMARY.

Report of a case of cysticercosis (*T. solium*) occurring in a healthy adult soldier, aged 26 at onset of first symptoms, after four and a half years' service in India. Condition at first exactly simulated cerebral tumour; headache, vomiting, optic neuritis, and fits. Examination by an expert neurological surgeon and physician failed to reveal the cause, and the patient was diagnosed "Post-Contusional Epilepsy" as he had received a minor injury to the head two years previously. Fits continued despite luminal and bromides, and further examination two years later revealed the presence of numerous subcutaneous cysts containing dead *Cysticerci cellulosæ*, one of which had been present for some time. Optic neuritis had by this time practically disappeared, leaving a secondary optic atrophy but with no diminution in the visual fields.

This case shows the importance of assuming that every case in which fits occur in a previously healthy adult who has lived abroad is one of cysticercosis until repeated examination over a period of years has failed to reveal the presence of cysticerci in the tissues either by palpation or by X-ray examination of the whole body.

NOTES ON THE CHARACTERISTICS OF THE NODULES, AND THE METHOD OF EXAMINATION FOR THEIR DETECTION.

(1) The palpable nodules lie mostly in the muscle substance or deep to the skin and subcutaneous tissues attached to the surface of the muscles.

(2) The skin and subcutaneous tissues move so freely over them that the impression given is that the cysts themselves are freely movable.

(3) They are all approximately equal in size and form in any individual patient, as they tend to come out in crops. In some patients, however, the nodules may be as large as a hazel nut though they are usually about the size of a pea. Their size depends very much on the length of time they have been present and the tension of the tissues in which they lie. The majority of nodules palpated feel about the size and shape of a medium-sized gelatine capsule. If the pressure were equal on all sides, they would be spherical, e.g. in the eye, but those that we have seen extracted from the subcutaneous tissues have all been elongated to some degree.

(4) They have a peculiar density, reminding one of cartilage in hardness and giving the sensation of lightly distended thick-walled bladders.

(5) They are painless and there is no skin reaction over them, no hyperæmia, swelling, or pigmentation.

(6) They tend to come and go, so that nodules palpated at one examination may not be palpable at a later date though fresh nodules may have appeared.

(7) They are most easily palpable in the upper part of the body, the abdominal wall, chest, back, arms, neck, and face.

The patient should be examined stripped and in a good light, preferably daylight. His skin should be closely scrutinized while he is told to move all his muscles in turn ; this will frequently enable the observer to see the nodules appear or move under the skin. If this fails, the patient should lie down and the inspection be repeated, moving the muscles as before. Finally, a thorough search should be made, palpating the whole body surface, at first running the hand lightly over the skin and then with deeper pressure and a kneading motion of the fingers feeling the substance of the muscles.

The authors wish to thank Colonel Benson, D.S.O., Officer Commanding the Queen Alexandra Military Hospital, Millbank, for permission to forward these notes for publication, and Colonel W. P. Mac Arthur, D.S.O., M.D., F.R.C.P.Irel. K.H.P., Consulting Physician to the British Army for his assistance.

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(1) MAC ARTHUR, W. P., "Cysticercosis as seen in the British Army, with special reference to the Production of Epilepsy." *Trans. Roy. Soc. of Trop. Med. and Hyg.*, vol. xxvii, No. 4, p. 343, and this *Journal*, 1934, lxii, 296.

Travel.

BEYOND LEH.

A SHOOTING TRIP IN LADAKH, 1926.

Being a Diary kept by

K. W. DICKSON, F.R.G.S.

(*Continued from p.* 376.)

XXIII.—GOOD-BYE TO LEH.

Next morning I got up for breakfast and saw R. off, but had to lie down as I was very sick and giddy. The room was like a Paddy's market with everything laid out for packing. However, I felt better by lunch time and got everything stowed away ready for an early start next morning.

We dined at the mission house and stayed much later than we intended, but it was our last night in Leh. Mrs. Kunick said at dinner that she felt she could go on for another year without a holiday, we had cheered her up so much. She felt it wouldn't matter now if she didn't see anyone for months. Her remark brought the fact home to us how very lonely they were in Leh, and how very plucky they were in their loneliness. Such selflessness was almost beyond my comprehension. We sat late round the table and talked of many things. They told us about people who had stayed in Leh; and of their work in still more lonely places, Poo and

Kailung. We were saying good-night and good-bye, when Mrs. Kunick insisted that we should come in for breakfast next morning at whatever time we wanted it. After some persuasion we promised to come in shortly after six o'clock.

The sun was just touching the top of the castle and the monastery heights when we went into their compound next morning, and we remembered it was the longest day. We let Ramzan, the sweeper, take the dogs with the baggage, and our ponies waited for us at the gate.

The first four miles from Leh were downhill to Spittuk, by the river, so we went on foot. Both ponies were fast walkers, and kept up well. A small rounded hill which divides Upper from Lower Ladakh was our objective for lunch, but thirst rather than hunger made us call a halt before we reached that point. The desolate appeárance of the Mani walls struck us afresh. I had asked Mrs. Kunick why there were so many broken-down chortens and Mani walls. She said that no merit was acquired by mending the walls and building up the chortens, so no one touched them, and they seemed to add to the desolateness of the countryside.

We had a few minutes' excitement as we thought we saw a memsahib in a white topee riding towards us. However, when we got nearer we found it was only a Yarkundi trader in a white leather hat lined with fur. It had the appearance of a lady's topee in the distance. His saddle was piled high with two gaily coloured saddle-bags, bright reds, blues and greens. The man himself might have passed for a Frenchman, certainly his skin was no darker. A caravan of ponies followed him with a Yarkundi servant. We were very amused to see two green parrots in cages tied on to the laden ponies.

Apricot trees do not grow so high as Leh, and I was surprised to see them as near as Nimu. The new copper-coloured leaves at the top of the branches caught our attention at once, after seeing poplars and willows only for two months.

We camped in the wood which surrounds the Dak Bungalow. We had dinner outside for the first time, the air was so warm and soft, and it was light long after we got into bed. A thousand feet lower does make a difference in the temperature. We slept with the tent wide open, and watched the light of the moon through the trees.

The first few miles to Saspul were in deep sand; we had impossible ponies, and we seemed to take hours to those few miles. Basgu is very picturesque, and we were unfortunate in getting no sunshine when passing through on our way to Leh. Now it was prettier, as little blue irises were in bloom, bordering the fields. Clouds came up, and we thought we were to be unfortunate again. There was just enough light to make it worth while to take a photograph.

The dogs did ten miles to our one on the plateau between Basgu and Saspul. There were no sheep on this barren stretch of country.

Tents were pitched in a garden amongst waving poplars. A monastery

overlooked the garden, and some interested lamas watched us at our evening meal. Saspul covers a large area where the river bends, the ground is somewhat level, and for a mile or two all this land is under cultivation.

We had two riding ponies for these marches, as R. had worked so hard after sharpu he had had enough walking for a bit, but we always did the first hour on foot. The ponies were following when some sound startled them, and off they went at a canter, and it was another hour before we reached them and they were caught.

Here we saw roses in bloom for the first time. They grew in crevices in the rocks, often large bushes, six or eight feet in circumference. On turning a corner one knew they were there, the scent was almost overpowering, it was so strong. The colour was a glorious bright magenta, not a soft pink like the English wild rose.

While following the ponies we met two ladies riding in thick coats and veils, and we said "Good-morning." We certainly would never know them again, their faces were completely hidden. A servant riding behind was carrying a gun across his saddle, and we wondered what he expected to shoot.

We opened our last tin of cheese for tiffin, but when the tin was opened it bubbled out and rose to twice its normal size, and had to be thrown away. This was rather serious as well as disappointing, as our stores were getting low. We had only one tin of butter and one of jam.

The river was getting more swollen and muddy every day with the melting of the snows. It was three times as large as it was on our outward journey. It was much warmer that day and I was tired, so we decided to do a half march from Nurla, and stop at Khalatse on the morrow. With meals out of doors, only one tent was pitched under a walnut tree, whose fresh young leaves had a delicious smell. Khazir But told us that two English ladies had camped at the far end of the village, but I had no energy to go along to see them, and we were off before they were about next morning.

The march to Khalatse was uneventful. We found the Dak Bungalow compound very dirty, too insanitary for a camping ground, so we walked on to the far side of the village and had found a suitable spot between fields, when Mrs. Burroughs and her little daughter Monica came towards us, and asked us to camp in their garden under the apricot trees. They had heard from Mrs. Kunick that we were coming, but had not expected us that day. It was hearing Garry bark that called their attention. Monica had said, "That isn't a Khalatse dog barking," so they came to look for us. We had tea and supper with them, and had a nice long afternoon talking. Mrs. Burroughs was anxious about Monica's eyes and R. was able to reassure her; then when he found that Mr. Burroughs did quite a lot of eye work, although he is not a doctor, they sat and talked together, Mr. Burroughs taking notes about treatment and operations. Although he lives so far from civilization he keeps himself up to date by reading.

That evening they kept us enthralled by telling us their experiences in Poo and Kailung; especially in Poo, where they had been the only white people, and their only visitor was the Forest Officer, who came once a year. It was in this station that Mrs. Kunick had been for five years without seeing another white woman. Mrs. Burroughs' second son had been born there, and ten days after his birth, while she was convalescing, word came that a man had had a terrible fall and split his skull and must have his head sewn up. Her husband had to do it, and she must go to the hospital above the house to give the chloroform. It was the first time she had given it, and she was scarcely able to stand, but as she said, their prestige in Poo depended on the man's recovery. During their first six months in Poo their house was just beside the village dancing ground. These dances, to the accompaniment of pipe, whistle and drum, took place three or four nights a week, and the crowds did not disperse until three or four in the morning. The missionaries could get little or no sleep, and found it difficult to carry on their work. The morals of the place were very low indeed. Mr. Burroughs said it is difficult to make any headway against the complacency of the Tibetan. He is a cheery mortal, but is too pleased with himself to be at all impressionable.

The path to Poo is a very bad one, and grain and small baggage is carried by sheep. The slopes are so steep that when the snow melts big boulders are loosened and come hurtling down across the path to the foot of the gorge, and up several yards on the other side. One day as they were returning from Simla (I don't remember the distance, but it was twenty-one days' march), Mrs. Burroughs was riding with her baby son on the saddle in front of her, when one of these boulders came thundering down from the hillside above and passed between the pony man and the pony. She said that the only thing her children were afraid of were these avalanches of boulders.

The mission at Poo has now been given up but there are still missionaries at Kailung.

Mrs. Burroughs was very amusing about visitors to Ladakh, and she always found them interesting. The youth who dances all afternoon when on leave at a hill station never goes to Ladakh. They often get queer people she said, but they always interest her.

The crops were much further on in Kalatse than in any of the other villages. The fruit had formed on the apricot trees, but would not be ripe for some weeks yet. Kalatse gets very little sunshine in the winter as a high hill rises to the south east.

We were as quiet as possible next morning striking camp so as not to disturb our host and hostess, and I had to see that the servants left the garden tidy. We heard a caravan passing while we were at breakfast and thought it was probably the Countess and Mr. Stuparitz, who we heard had spent the night at the Dak Bungalow.

We had a specially nice tiffin on the road to Lamayuru as Mrs. Burroughs

had given us lettuces, and we sat by a stream and let the baggage pass us. It was very hot and tiring climbing up the gorge, so we determined to start an hour earlier next day and get the better part of the march over before the sun was high.

I went up to see Madam Toeplitz while R. went out after chikor. She didn't seem to be enjoying her trek very much. She was writing a book about Lamaism, and spent all her leisure writing and studying. Mr. Stuparitz

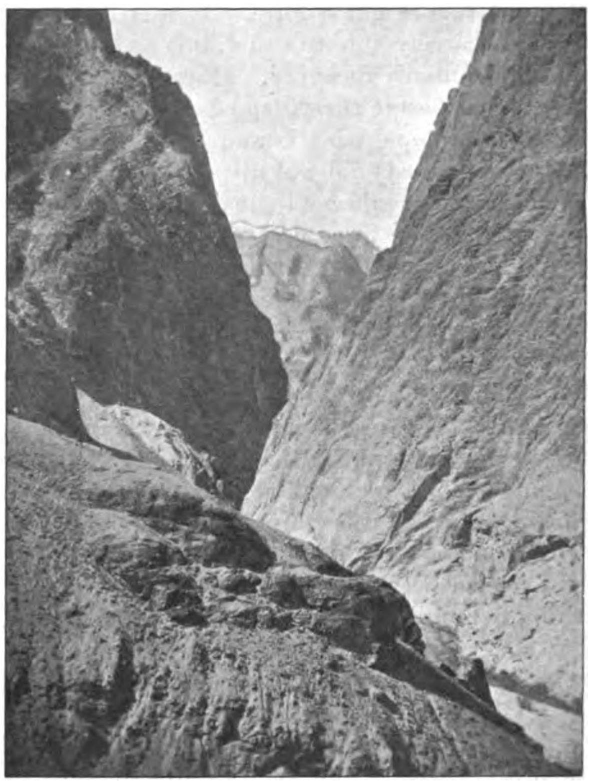

FIG. 25.—A gorge.

was very anxious to see the sharpu head. He had heard about it being found, and came down with me to the wood where our camp was pitched.

We had told our bearer to wake us an hour earlier than usual, but in his anxiety not to be late he brought our tea at 3 a.m., so we got up and dressed by candle-light. Breakfast in a dark wood, a moon shining through the trees above, and a candle on the table, was like some scene outside a robber's cave. We were well on our way before the dawn broke, and later the old monastery stood out against the morning sky. R. thought it was too cold, but walking was a sheer delight on such a frosty morning. I always enjoy getting over a pass, and that day was no exception. We met

about 200 yaks and ponies coming towards Leh. I was riding quietly uphill when suddenly I saw a yak advance on Garry and toss him in the air. Luckily the horn caught in his collar, so he was not hurt, and I thought he would know better than to get in a yak's way another time.

From the top of the pass we had a long look at the Leh hills, all a soft purple in the morning light. The path was clear and open on the far side, so we raced downhill for about two miles. R. got a good photograph of a rocky clump of hills with snowy peaks on the other side of the gorge.

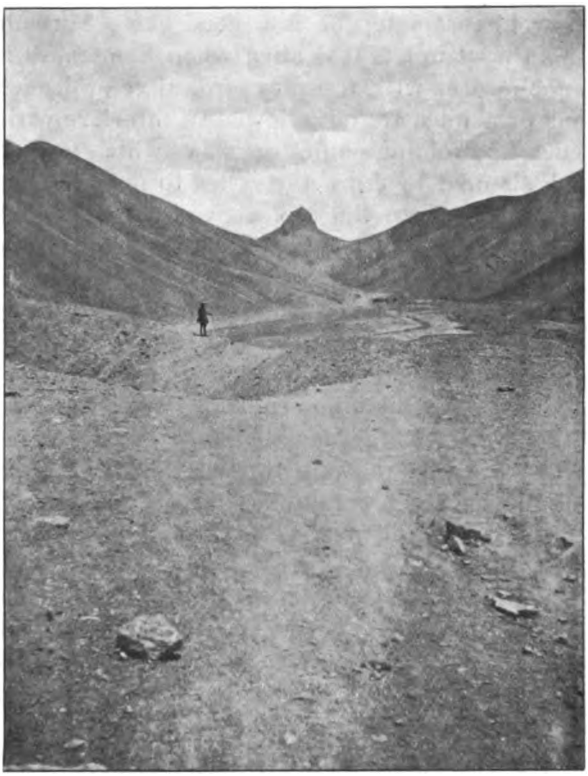

FIG. 26.—The peak at the summit of the Namika La Pass, 13,000 feet.

Our one tin of pâté de foie gras was opened for tiffin and eaten along with the last of Mrs. Burroughs' lettuce.

Bodh Kharb was white with snow when we left it on our way up; now there were crops coming up everywhere, and the camping ground was a pretty one. We did not start so early as bearer would have liked for the next pass, the Namika La; he tried to get us away by half-past four. It was a monotonous road to the foot of the pass.

Every day we met more traders with their strings of ponies. I had a nice grey Zanskar pony and rode to the top of the pass. I climbed the little peak on our left to get a better view of the Leh hills 50 miles away.

They were a lovely colour, soft reds and browns and purples. The valley on the far side is a most desolate one; even in June there was no vegetation and no water. We stopped at a milestone 149 miles from Srinagar, and R. took a photo of the pass with the peak in the distance.

We camped on the polo ground at Moulbeck, and I cut R.'s hair, much to the amusement of the villagers who watched from the cliffs above us.

Our larder was getting low, so R. went out with the khansamah and they got 13 pigeon. The natives were delighted as the pigeons were in such numbers and they were eating the crops. We were very amused at Hassan Shah, our khansamah; he is a good caste Mussulman and will not cut a pigeon's throat unless it is alive when he catches it. When the Kashmiri tiffin coolie goes with R. every bird, alive or dead, has its throat cut; his religious principles are not allowed to interfere with his appetite.

We had a pair of stumbling ponies next day which made the way seem longer. We had planned to cross the valley to get a photograph of the monastery which is built into the cliff above Shergol, but it was further than we thought. I saw villages far up the mountain sides which had been scarcely visible on our way up, the houses being the same colour as the mountains. Now that the crops were green, they were a marked feature of the landscape. The crops in the Lotson valley were the finest we had seen. There is a plentiful supply of water there. The wild roses were wonderful; bushels of flaming crimson. We were constantly seeing new flowers at this stage. A few days before we had seen nothing but the caper plant growing in the bare shale on the hillside. It spreads along the ground and has a flower which is reminiscent of the passion flower. I had no idea what plant it was until we were having supper with the Burroughs at Khalatse when Mrs. Burroughs tried to make me guess what it was. Even when she told me I imagined it was the seed capsule which was the caper, but she said it is the bud of the flower which is pickled for sauce.

It was warm that morning and we sought shade on the far side of a stream for our lunch hour. We saw the servants and baggage passing as we smoked a pre-lunch cigarette. R. called to Kelpie, who pricked his ears and when he saw us, took no thought about picking his steps in mud or stream, but galloped through both, and arrived a dripping mass on my lap very pleased with himself.

We did not attempt to go on to Kargil that day but stayed the night in a little wood beyond the village of Lotson, almost under Tapi.

XXIV.—Kargil.

We got a good start for our half march of eleven miles next morning. The sun was behind a cloud and it was quite cool. It was interesting to see the irrigation channels of Tapi built up for miles along the hillside far above us. The village itself lies in the top of a cliff, I should think 600 feet above our path.

We again found several new flowers and tried to press them. I did not

know then what a paradise of flowers we were coming to in Kashmir. As we came through the long straggling village of Pashgyam there were roses everywhere, again wild roses of course; the bushes as large as those in Devonshire lanes, but the flowers are larger, and when they first come out are brighter than a Dorothy Perkins rambler, but in the strong sunshine they rapidly fade to a pale pink. Some of the bushes were really wonderful, they held such an amount of blossom.

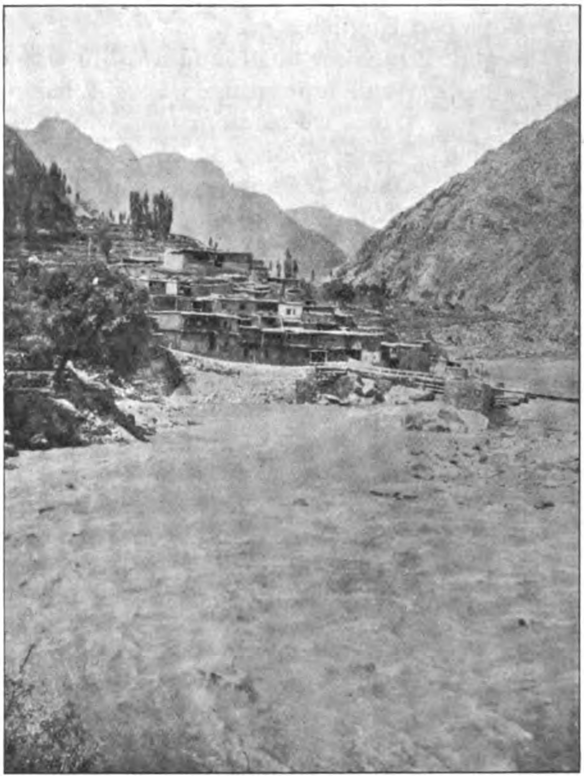

FIG. 27.—Kargil, bazaar and bridge.

At least a dozen caravans of ponies passed us on our short march from Lotson, going up either to Leh or Yarkund. If I were a millionaire I would start a hospital for these poor ponies, but a law would have to be passed to have them examined at certain stages and detained when unfit. It is very distressing to see tiny ponies very lame with swollen joints, their bodies thin with pain and want of food, being whipped to make them keep up with the rest of the caravan. Ladakhis do not beat their ponies as Indian tonga drivers beat their horses, but at nearly every stage we saw the remains of a poor pony that had fallen by the wayside. Eight ponies all showing ribs, with horrid sores on their backs, were being driven down from Kargil to Kharbu, and we passed and repassed them on the road.

It was a fine march, with a cloudy sky, over the plateau to Kargil, the barrenness a great change after the fertile fields of Pashgyam. We rested at the top of the downward path and R. took a photograph of the Suru nullah. The valley of the river with big shadows here and there would have made a nice sketch.

Our stores were running short and we made out a list of things to get in the bazaar at Kargil. We were at our last tin of butter and jam. We had bought candles and matches there on our way up, and the shikari said that by June the shops had English stores.

I rode up to the Dak Bungalow but found a sahib was occupying half of it, and it looked so dirty and uninviting, we went back down the path and sat in a willow grove. Here we read our mail which had been waiting for us at the Post Office. Waterproofs had to be pulled out and my old parasol put up as it rained steadily for a quarter of an hour. I quite enjoyed the rain, and it laid the dust before the baggage arrived. Then we hurried off to the bazaar to buy our stores, only to find that the only thing on our list to be had in the bazaar was Sunlight soap. We had no tinned fruit, tinned meat, jam, butter or cheese. There were no vegetables except potatoes to be had and very little meat, so when I came back I had to give some time to a readjustment of our menu. We had enough sugar, flour, dried fruits including raisins, but these do not make for variety, and tea is a difficult meal without butter or jam. However, we could get eggs, and I bought a lot of milk when possible so as to get the cream. One of khansamah's new sultana cakes seemed very good when tea time came.

We had mail letters to answer. I was very tired at night and my temper was short (in consequence only I hope). When Jit Ram knocked over and broke our precious large thermos flask, I was really cross; it seemed the last straw We had always carried hot coffee or cocoa for tiffin in this quart bottle, and now if we wanted a hot drink, a fire would have to be made, and in many places there was no wood. Looking back on it now, I really should have been grateful that the thermos had remained intact so long. What we should have done without it in these snowy regions I do not know.

The shikari brought two riding ponies for us to look at. They were fine strong animals, two hands larger than any we had ridden, and much better cared for. The sahib at the Dak Bungalow had brought three Kashmiri men with nine ponies as far as Kargil, and now the men were anxious to get work on the way back. The two ponies we were to ride had only pack saddles; a blanket over the wooden fork which forms the base of the pack saddle. There were no stirrups of any kind, but they adjusted loops of rope. I was not very sure about it as these were big animals, and I didn't want to be dragged by a rope if I came off. However, I agreed to try the rope, as it is very tiring going a long journey without stirrups.

Next morning, while we were enjoying our usual ten minutes' halt at the end of the second hour an officer and his wife appeared round the

corner, riding the usual tiny ponies. They stopped, and we had quite a long talk. He was a Major Williamson, a Gunner from Calcutta. They must have made a very early start from Kharbu, as they had already done about twelve miles. He had taken a block in the Chang Chen Mo for antelope, so they had to cross the Chang La, a pass over 18,000 feet. Mrs. Williamson looked very white and delicate and I wondered how she would stand the rough journey. A man has the interest of the shikar to keep him going, but a woman has to be pretty keen on the trek itself. She was very interested to hear how I had got on. I felt very tough and weatherbeaten beside her, but she had been wearing a dark veil to protect her face.

We managed to light a fire of dried grass among the rocks to make our coffee, but the milk had gone sour, and I don't appreciate black coffee; to me it has associations with sea-sickness. We had a cold pigeon each, so fared very well even without butter and jam.

The Kashmiri pony went well, with quite a different action from most of the poor little Ladakhi ponies. Four or five miles from Shimsha Kharbu we saw a great storm coming over the crags far above us, and in a few minutes we had to stop and put on waterproofs. I got very wet indeed, but I quite enjoyed the storm, even the heavy hail, it was such a delightful change after the dry air of Ladakh. Unfortunately the sky was so threatening we thought it unwise to pitch our tents, as we could not risk having heavy wet tents to carry next morning, and we were compelled to go into the not over-clean bungalow. We had our meals on the verandah, however, and I even had the beds made up in a sheltered part of it too. The verandah was just a few feet back from a steep bluff rising from the river Dras, which was then a roaring torrent. We could hardly hear each other speak for the roar of many waters, and we remarked as we went to bed, how often our camp had been pitched by a river and we had dropped off to sleep with its roar in our ears. It certainly did not keep us awake that night.

A Sahib and Memsahib arrived at the bungalow very late, but we were up and away next morning before they were astir. It was so bitterly cold on the first part of our march to Dras that we hardly rested at all, and it was too cold to ride. The path lay in deep valleys, so the sun was longer in reaching us. When I did ride again the Kashmiri man told me that his pony had eaten "kharab ghas," i.e. deadly nightshade, and he was afraid he would be very ill. I told him the Sahib would look at its eyes, and could probably give it some medicine. Still the poor man was so worried he spoke to everyone he met on the road and asked their advice about it. First a small boy with a raucous voice walked about three yards behind me with the men, giving his ideas about the symptoms and what should be done. Then a man he met by the roadside told him to give the pony two seers of hot milk (about two quarts). Later we came to a village where a man walked alongside feeling the pony all over as I rode, and saying his

word about it. In a few minutes the man said he must take the pony back to the village to give it a draught of warm milk. By this time I was thoroughly annoyed, and asked him if he did not believe what the Sahib said. He looked sulky, but I allowed him to take the pony away, as nothing else would satisfy him.

I rode R.'s pony for a mile or two, when to my surprise the man made up on us. He could get no milk in the village as the goats were all out at pasture. So I rode the pony again but soon saw flies settling on its left ear, so I asked if it had hurt itself. Then it came out that he had let the man put a knife in to bleed the poor animal. We took longer on the road on account of all this trouble with the pony.

It was extraordinary to see the difference in the countryside; even up the sides of some high hills it was green like a picture of the Alps, and the Dras valley was a plain of verdure in the afternoon sunlight. Opposite Tashgyam the rising ground on the far bank of the river was covered with wild rose bushes, and on either side of our path among the stones and rocks was a plant resembling hedge parsley; the flowers were yellow and the leaf like sprengeri fern. I noticed cows eating it with zest, so it must have been some use for fodder. There was a great deal of deadly nightshade on waste ground here too, and round the edges of the tiny fields, but not so much as in Ladakh; there it seemed to grow everywhere.

We sat beside the river and I used the small amount of spirit I had left to boil the kettle for tea about three o'clock. We did not arrive till after four, having been on the road for ten and a half hours.

(*To be continued.*)

Current Literature.

ELDERTON, ETHEL M. **The Lanarkshire Milk Experiment.** *Ann. of Eugenics.* 1933, v. 5, 326-36, 12 diagrams.

PEARSON, K. **Appendix to Dr. Elderton's Paper on "The Lanarkshire Milk Experiment."** *Ibid.* 337-8.

For four months in 1930 in certain schools in Lanarkshire 5,000 children were given three-quarters of a pint of raw milk a day and 5,000 children in these same schools were selected to act as a control series; in another set of schools 5,000 children were given three-quarters of a pint of pasteurized milk and another 5,000 children served as controls. The children were measured and weighed at the beginning and end of the experiment. The results were reported by Leighton and McKinlay [*vide* this *Bulletin*, 1931, v. 6, 436] but have been criticized on various grounds [in papers referred to in this study]. One difficulty was that the initial heights and weights of the children in the control series were greater than

those of the children who were milk fed. To overcome this all undergrown and overgrown children have been excluded from the original data, and the comparison confined to children in the three classes who had, within fixed limits, the same initial height and weight, i.e. average children. It is concluded from this sample: (1) That those who had extra milk generally gained more in height and weight than those who did not; (2) that girls gained more weight than boys and older girls more than younger, the difference with age being greater with raw milk than pasteurized milk; and (3) that there is no evidence that raw milk has an advantage over pasteurized in increasing growth, or pasteurized over raw. [Conclusions (1) and (3) agree with those drawn by Leighton and McKinlay. With regard to (2) they concluded that there was no obvious or constant difference in growth between boys and girls and little evidence of definite relation between the age of the children and the amount of improvement.]

Professor Pearson's tests lead to the conclusion that the acceleration of growth in weight is not definite for the boys. He suggests that possibly the milk giving greater growth to the boys also gives them greater energy and does not lead to greater weight than in the control series, because owing to the greater energy the additional nutrition is dissipated in exercise, whereas in girls the administration of the milk may lead to a storage of this additional nutrition and not be spent in greater activity.

A. Bradford Hill.

Reprinted from "Bulletin of Hygiene," Vol. 9, No. 4.

Albert, F. C. **Scholarship Improved by Light.** *Trans. Illuminating Engineering Soc.* 1933, v. 28, 866-71, 5 figs.

The direct cost of adequate lighting of school rooms, without proven figures of the indirect cost of insufficient and improper lighting, has caused too many of our school buildings to be inadequately lighted.

For three years, comparison of artificial lighting has been made in a couple of similar class rooms, 28 feet long, 21 feet broad, and 12 feet high, facing north. Room A was lighted by two 150 watt, ceiling type, prismatic globe lumières controlled manually by a wall switch, and giving 6 foot candles on the central and 2 foot candles on the most remote desks. Room B had four totally indirect fixtures, each with a lamp of 300 watts, controlled by an automatic photoelectric relay to give 12 to 14 foot candles on all desks. The other rooms of the school had about 5 foot candles average.

Over the three years of observation the use of the artificial lighting in the manually controlled room was slightly increased, but averaged 12 per cent of the school time; the automatically controlled lighting of room B averaged 35 per cent of the time.

The rooms were occupied by teachers each using similar methods of work, with about forty pupils of the same grade and selected as of equal ability by performance tests. The teachers recorded the scholars in

room B as alert, cheerful and attentive; whilst those in room A were restless and sleepy on dark days, and harder to teach. Apart from this, room A with manual control of lighting had 115 pupil years with 23·7 per cent "failures," whilst room B with automatic lighting, had 112 pupil years, with 8·8 per cent "failed." As the additional cost of lighting for room B was 24.3 dollars per year, and the actual operating expenses of education is 28 dollars per head annually, the obvious benefit of the increased outlay on lighting makes it seem well worth while.

[For general school work five foot candles is the recommended standard, and as the effectiveness of light for seeing varies approximately with the logarithm of its intensity, there is little temptation to exceed this standard. It is now suggested that automatic adjustment to higher values is well repaid by the increased educational efficiency, chiefly through abolition of the wasteful hours of dark accommodation, in the gloamin'.]

JAMES KERR.

Reprinted from "Bulletin of Hygiene," Vol. 9, No. 4.

HEKTOEN, L. and JOHNSON, CHARLOTTE. **The Prevention of Diphtheria and Scarlet Fever in Nurses.** *J. Amer. M. Ass.* 1934, v. 102, 41-2.

Since the opening of the Durand Hospital, Chicago, in 1913, special efforts have been made to protect the nurses against diphtheria and scarlet fever; the hospital consists of sixty beds mostly occupied with cases of diphtheria and scarlet fever. Since 1913, 3,673 cases of diphtheria and 5,416 cases of scarlet fever have been treated in the hospital. The cases have been mostly attended by student nurses who came from other hospitals for a three months' tour of duty. (They were in no sense "seasoned nurses" but were mostly recent arrivals in Chicago.) Except as determined by chance each nurse came into equally close contact with diphtheria and scarlet fever cases. During the period 349 nurses were found to be insusceptible on original Schick test and of these six have developed diphtheria, and of 397 nurses rendered Schick negative by immunization before entering on duty, one developed diphtheria. The incidence among Schick-negative nurses of both groups was 0·89 per cent and it is noted that no cases of diphtheria have developed since December, 1927.

Before Schick-testing and immunization had been introduced, the nurses (thirty-eight in number) showed an incidence of diphtheria of 18·4 per cent. With regard to scarlet fever the incidence among the nurses before Dick-testing and immunization was 7·7 per cent. After Dick-testing had been introduced it was nil among 309 nurses who were Dick-negative on original test, and nil among 200 Dick-positive nurses who had been rendered Dick-negative by immunization before admission to hospital duties. Two cases of scarlet fever occurred in a group of eighty-nine nurses who were immunized while in actual service in the hospital. No

cases of scarlet fever have occurred among the nurses since December, 1927. The results in this hospital thus show that Schick-negative and Dick-negative nurses are well protected against diphtheria and scarlet fever respectively.

C. C. OKELL.

Reprinted from "Bulletin of Hygiene," Vol. 9, *No.* 4.

JOHNSON, C. D. and GOODPASTURE, E. W. **An Investigation of the Etiology of Mumps.** *J. Exper. Med.* 1934, v. 59, 1-19, 3 charts and 7 figs. on 3 pls.

The authors record a series of observations on monkeys from which they conclude that they have demonstrated that mumps is due to a filtrable virus. Saliva from cases in the early stages of the disease was injected, in two cubic centimetre amounts, into each parotid gland through Stenson's duct. Four of six samples of saliva examined gave positive results. In these cases there was an immediate swelling of the gland, associated with the injection and increasing during the following twelve to twenty-four hours. This subsided within seventy-two to ninety-six hours of the inoculation and was followed, on the fifth to eighth day, by a well-marked secondary enlargement associated with œdema of the surrounding tissues. The initial enlargement was in some cases associated with a transitory rise in temperature and the secondary enlargement with a more definite febrile reaction. There was a transient rise in the leucocyte count during the phase of initial enlargement, followed by a progressive fall associated with an absolute and relative monocytosis and a relative lymphocytosis.

Saliva from two normal individuals produced only the transient enlargement following the inoculation.

Most of the monkeys were killed in the stage of secondary swelling and œdema, and the parotids removed for histological examination. They showed degenerative and necrotic changes in the epithelial cells, associated in some instances with a mononuclear and lymphocytic infiltration. Inclusion bodies were not demonstrated.

Using emulsions of these glands, the authors were able to transmit the infection through seven successive passages. With this material it was found possible, in each of five experiments, to transmit the disease with filtrates through Berkefeld V or N candles, although filtrates of the saliva from human cases had not proved infective.

Two monkeys that had been allowed to recover from an initial infection were reinjected with virus. They proved resistant, while a control animal developed the characteristic lesions.

Attempts to demonstrate the neutralization of the virus by the serum of human subjects who had recovered from mumps were inconclusive, but only two experiments were carried out.

W. W. C. TOPLEY.

Reprinted from "Bulletin of Hygiene," Vol. 9, *No.* 4.

STOCKS, P. **On the Spread of Smallpox in Partially Vaccinated Communities. Part I. The Stepney Epidemic of Variola Minor, 1929-30. Part II. Variola Minor in Durham and Neighbouring Counties, 1922-31.** *Ann. of Eugenics.* 1933, v. 5, 192-233 ; 302-10, 9 figs.

I. In Stepney in 1929 it is estimated that the proportions in the first three decades of age who had been vaccinated were about 45, 65 and 80 per cent respectively. This did not suffice to protect the community from an epidemic. In the 643 households attacked by smallpox, however, the corresponding proportions who had ever been vaccinated were only 12, 29 and 43 per cent. There was a steady decline in attack rate amongst unprotected home contacts after the epidemic had become diffused, which indicates either that the virus became progressively less infective or that latent immunity was being acquired by the population. Evidence in favour of the latter hypothesis is discussed.

The most frequent incubation period was fourteen days ; in one-eighth of the cases it appeared to lie outside the limits of twelve to sixteen days but very rarely can it be less than ten or more than eighteen days. When a case was removed to hospital on the day of appearance of the rash, the subsequent attack rate amongst unprotected home contacts was significantly less than in cases where removal was delayed. The attack rate increased from 8 per cent when four days elapsed from onset of symptoms to removal, to 25 per cent when eight to eleven days elapsed. The primary cases of smallpox showed a relative excess of young adults in comparison with the secondary cases, which suggests that smallpox is spread in workplaces more than in schools. Comparing the actual attacks with those expected in the same age distribution of unvaccinated persons, vaccination of unprotected contacts within two days of appearance of the rash in the first case reduced the risk of immediate attack to one-seventh, vaccination three or four days after reduced the risk to one-quarter, vaccination five, six, or seven days after reduced it to two-thirds, but with longer intervals there is no evidence that it was effectual. The aggregate risk of immediate attack to unprotected contacts of all ages was 1 in 4. At ages under 20 the risk to those vaccinated in infancy only was one-twentieth of that to the unvaccinated, at ages 20 to 40 about one-tenth, and at ages over 40 about one-half. For statistical purposes "protection" after vaccination may be regarded as adequate for 30 years, though it is no longer at its maximum potency after 20 years. Amongst persons vaccinated within 5 years about 1 in 150 may be expected to contract variola minor when exposed to infection in the house. The risk to unvaccinated persons in an infected house appears to have been considerably reduced when more than half the persons living in the house were protected by vaccination, the important factor being the ratio of protected to unprotected persons rather than the actual numbers of each.

II. Variola minor showed a very evident seasonal trend with its

maximal incidence in the second half of January and minimal incidence from mid-August to mid-October. There was a strong tendency for an epidemic of smallpox to become established more readily in those districts where the population was more densely housed, and also a tendency when an epidemic was established for a larger proportion of the population to be attacked where the overcrowding was greater. Overcrowding tended, however, to be associated not with an increase in the intensity of the epidemic in a given time, as might be expected, but with a prolongation of the epidemic at the ordinary level of intensity.

A. BRADFORD HILL.

Reprinted from "Bulletin of Hygiene," Vol. 9, No. 4.

TORRES, C. M. and TEIXEIRA, J. de C. Étude des inclusions cellulaires de l'alastrim et de la vaccine chez le singe (*Silenus rhesus*). [**A Study of the Cellular Inclusions of Alastrim and of Vaccinia in the Monkey (Silenus rhesus).** *C. R. Soc. Biol.* 1933, v. 114, 967-8, 6 figs.

A previous paper [this *Bulletin*, 1933, v. 8, 407] described investigations into the lesions which resulted from inoculating monkeys with alastrim. The present note describes a comparative study of the inclusion bodies found in these cases and the Guarnieri bodies seen in the pustules resulting from inoculating monkeys with heifer vaccine virus. In both cases the experimental animal (*Silenus rhesus*), the tissues examined (vesicles and pustules), and the staining and mounting technique were identical. The protoplasmic inclusions of alastrim stained strongly with hæmatoxylin. Generally single but occasionally two in number in the young stages, they were invariably single in the later stages when they became larger than the cell nucleus. The inclusions of vaccine (Guarnieri bodies) on the other hand, usually basophil but sometimes staining with eosin in the young stages, were always present in numbers in each cell. The vaccine inclusions in the same cell were stained some bluish grey and others pink while the single inclusion of alastrim remained basophil throughout its development.

O. K. WRIGHT.

Reprinted from "Bulletin of Hygiene," Vol. 9, No. 4.

Reviews.

JUBILEE BOOK PUBLISHED IN HONOUR OF DOCTOR PAUL DERACHE, Lieutenant Général Médecin, Inspector General of the Belgian Army Medical Service. Published in Brussels, April, 1933.

The jubilee of Lieutenant-General Paul Derache has been celebrated by the issue of a Jubilee Book, containing an introductory note by Queen Elizabeth, who has had personal knowledge of his work since the beginning of the Great War. Early in his service General Derache gained experience of administrative duties when on the staff of the Inspector General of the

Medical Service, and later, while on regimental duty, he developed great skill as a surgeon.

At the beginning of the War he was assistant to Inspector-General Melis, with whom he remained till early in 1915, and during this period, while taking part in the arduous administrative duties entailed by the movements of the Belgian Army, he found time to perform a considerable amount of surgical work. He was then placed in charge of the surgical hospital, Cabour, which was established at Adinkerque, and, later, moved to Bevern-sur-Yser, where his surgical capabilities found full scope, and *le Patron*, as he was lovingly called by staff and patients, became almost a patriarchal figure. He trained many surgeons, and at the present time the officers in charge of the surgical divisions of the Belgian hospitals are his old pupils.

General Derache has held the post of Professor of Surgery at the Army Medical School, and in 1925 was elected President of the Société belge de Chirurgie, an honour not previously accorded to an officer of the Army Medical Service.

The main part of the Jubilee Book is occupied by eighteen articles on surgical subjects written by officers of the medical service and others who have worked under General Derache.

The last few pages tell us of the Bevern Club, which meets annually in Brussels, when the surgeons of the famous hospital foregather to renew war-time memories and to do honour to *le Patron*, whose képi and cigar have become legendary and are familiar to those who have attended the meetings of the Congress of Military Medicine and Surgery.

An excellent photograph of General Derache forms the frontispiece of the volume.

Accompanying the book is a symbolical drawing of a wounded soldier resting in the arms of an Angel of Mercy, and the same drawing is faintly shown on the front cover.

POCKET MONOGRAPHS: URINARY INFECTIONS. By Clifford Morson, O.B.E., F.R.C.S.Eng. London: John Bale, Sons and Danielsson, Ltd. 1933. Pp. 76. Price 2s. 6d.

In this monograph of seventy-six pages, Mr. Clifford Morson has succeeded in giving much useful information on an enormous subject.

Colon bacilluria is dealt with in two chapters, and a description of the ketogenic treatment is included. General pathological considerations, urinary tuberculosis, genital tuberculosis, coccal infections, infection and renal function, stone in the urinary tract, and urinary infections in childhood are given one chapter each.

The final chapter, on the prevention and treatment of post-operation infections, appears to be more suitable for the specialist surgeon than for the practitioner, not a specialist in urology, for whom the book is obviously intended, and to whom it can be recommended as giving an excellent survey of the present-day methods of diagnosis and treatment of urinary infections, and the limitations of these methods.

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C.N. = Clinical and other Notes.
C.L. = Current Literature.

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